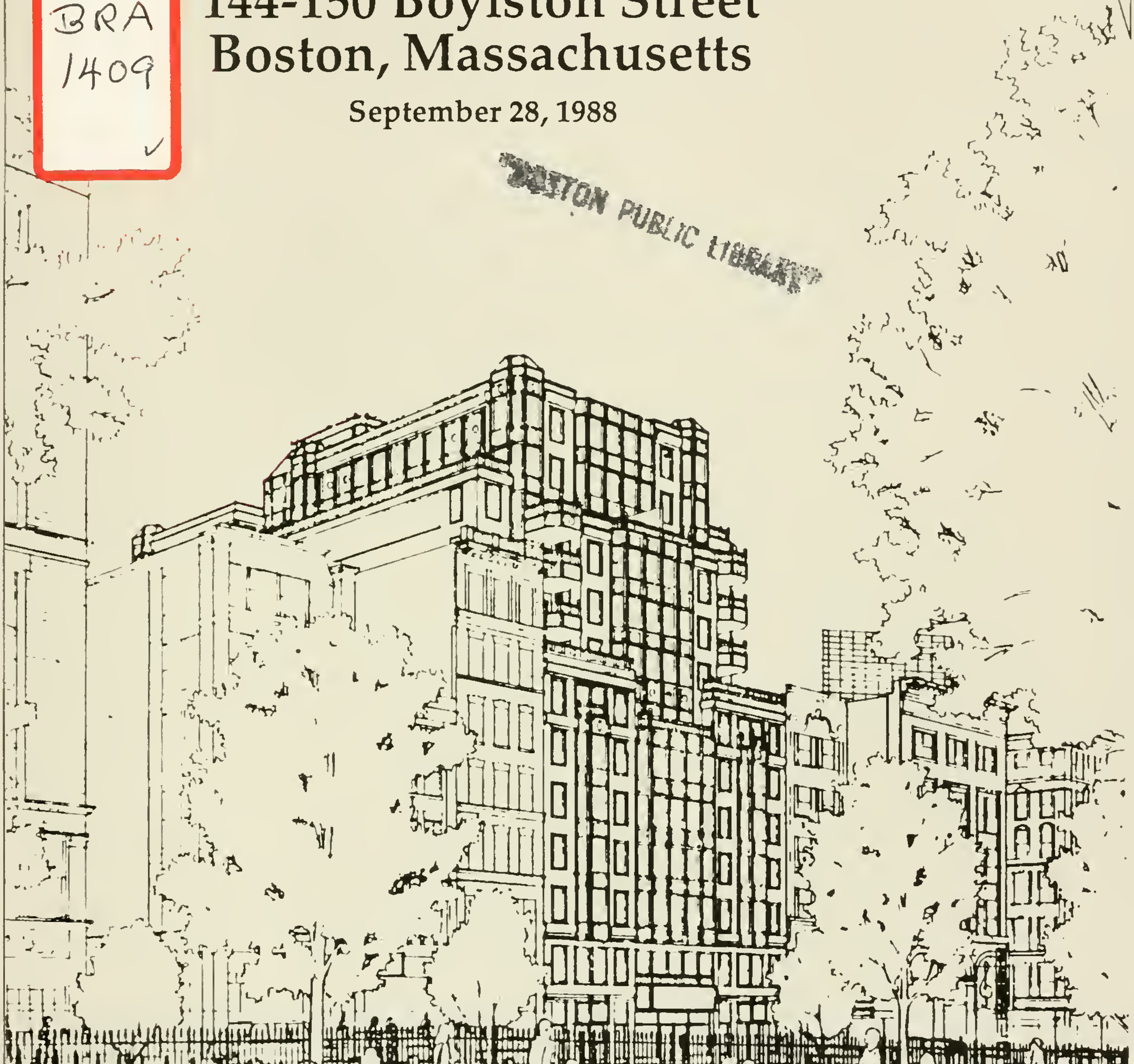
DRAFT PROJECT IMPACT REPORT
for
144-150 Boylston Street
Boston, Massachusetts

September 28, 1988



Submitted to:
BOSTON REDEVELOPMENT AUTHORITY

Submitted by:
FOX/LDD PARTNERS OF BOYLSTON STREET
47 Winter Street
Weymouth, Massachusetts 02189

Architects
JUNG/BRANNEN ASSOCIATES, INC.

Geotechnical Consultants
HALEY & ALDRICH, INC.

Environmental Consultants
HMM ASSOCIATES, INC.

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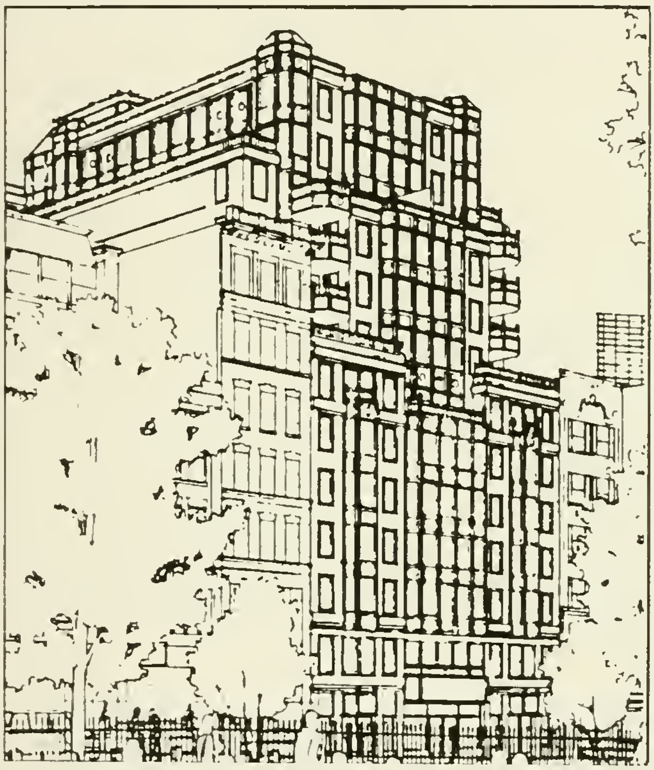


I. PROJECT DESCRIPTION & SUMMARY OF IMPACTS

I. PROJECT DESCRIPTION AND SUMMARY OF IMPACTS

1.0 Site Location and Surroundings

The proposed project is to be built on lots 144–150 Boylston Street on the south side of the Boston Common. The State Department of Transportation Building is located south of the site. Boylston Place, a pedestrian way connecting the Boston Common to the Department of Transportation Atrium, is located approximately 80 feet east of the site. Vehicular access to the site is gained from Boylston Street to Carver Street and an open paved area which also serves the Department of Transportation Building. Figure I–1 shows the specific location of the site within the neighborhood.

The site includes approximately 11,500 square feet on three parcels. There are two buildings on the site, one at 144 Boylston Street and the other at 150 Boylston Street. The middle lot is currently vacant. The two buildings on the site will be demolished. One was recently gutted by fire and is vacant; the other, the smallest on the block, is a small brick rowhouse altered by storefront retrofits. Figure I–2 shows survey information for the site detailing its configuration in relation to the surrounding structures.

The majority of nearby buildings contain office space on the upper floors and retail concerns at street level. Recent developments on the edge of the Boston Common and Public Garden in the general area of the proposed project have been primarily residential in nature, again with ground floor retail uses. Figure I–3 and I–4 show the predominant land use and ground level land use within the project area, respectively.

2.0 Project Description

The proposed project will contain residential condominium units, a small health club, commercial space and parking. The residential and retail entrances to the development will be located along Boylston Street. Vehicle access into the garage will be from Carver Street to the rear of the site. Figure I–5 shows the various entrances to the proposed building.

The building will be 125 feet high measured from Boylston Street, with major setbacks at the seventh and eleventh levels and various balconies and roof decks at other locations, to modulate the scale of the facades and provide amenity to the occupants of the building. The portions of the project visible above adjacent existing buildings will be massed in three distinct volumes, a residential volume in the front of the site and one in

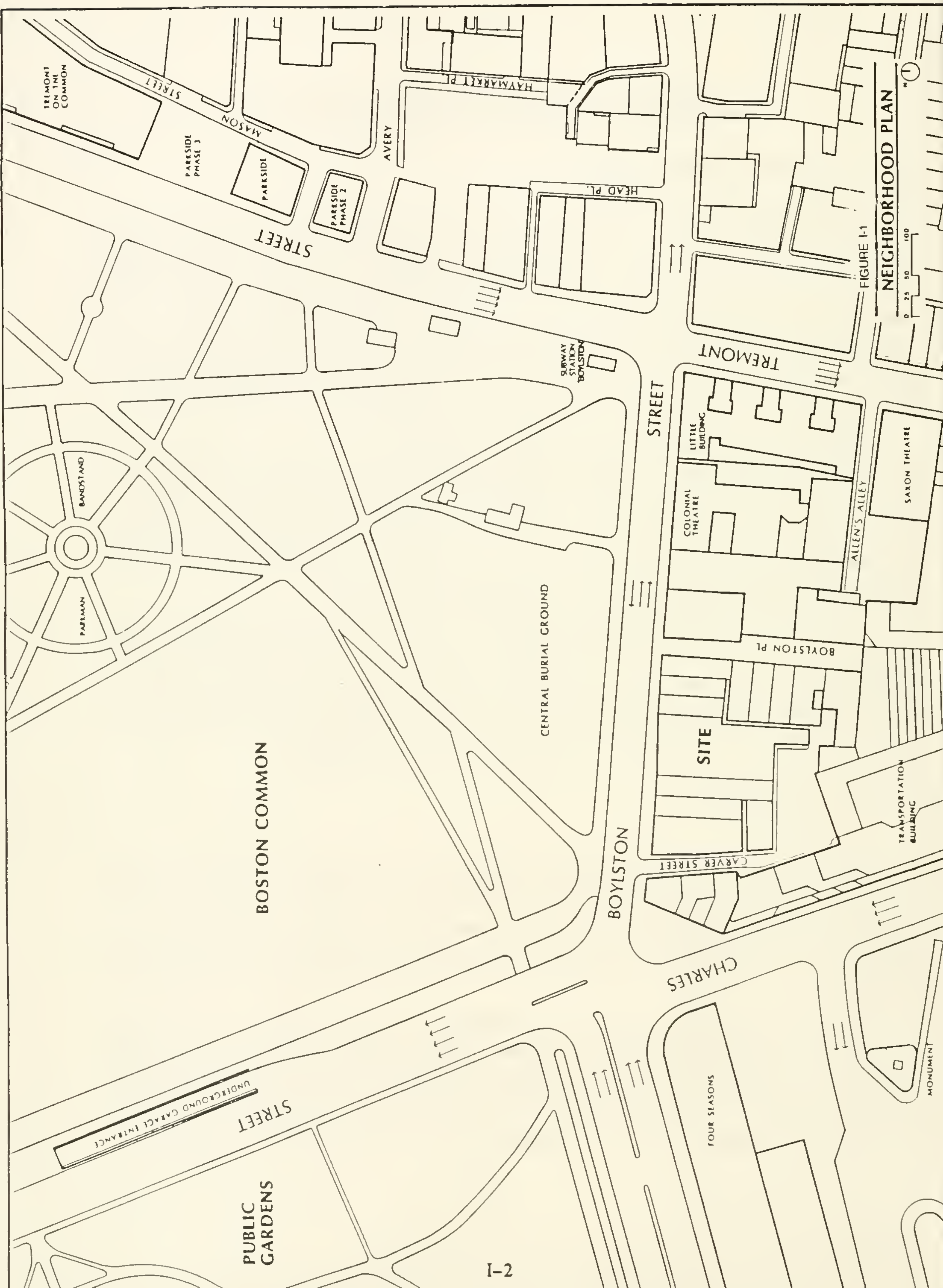


FIGURE I-1
NEIGHBORHOOD PLAN

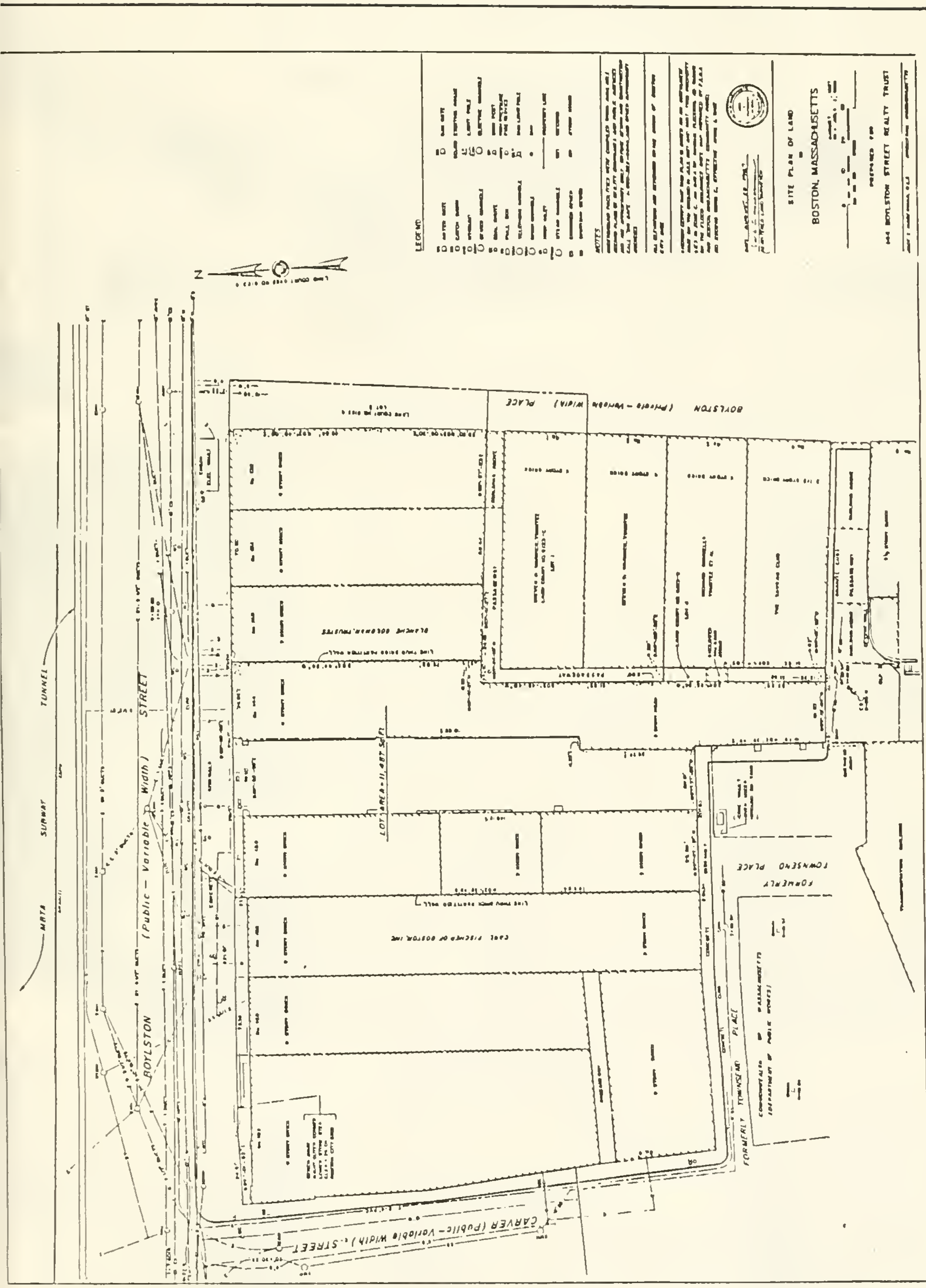


FIGURE I-2
SITE SURVEY

LEGEND
PUBLIC SPACE
RESIDENTIAL
RETAIL
OFFICE
PARKING
HOTEL
THEATRE
VACANT
FUTURE CONSTRUCTION
FIGURE I-3
PREDOMINANT LAND USE
0' 25' 50' 100'
TREMONT ON THE COMMON
MASON STREET
HAYMARKET PL.
AVERY
HEAD PL.
PARKSIDE
TREMONT STREET
SUBWAY STATION
BANDSTAND
PARKMAN
BOSTON COMMON
CENTRAL BURIAL GROUND
BOYLSTON STREET
ALLEN'S ALLEY
SITE
CARVER STREET
CHARLES STREET
FOUR SEASONS
UNDERGROUND GARAGE ENTRANCE
PUBLIC GARDENS

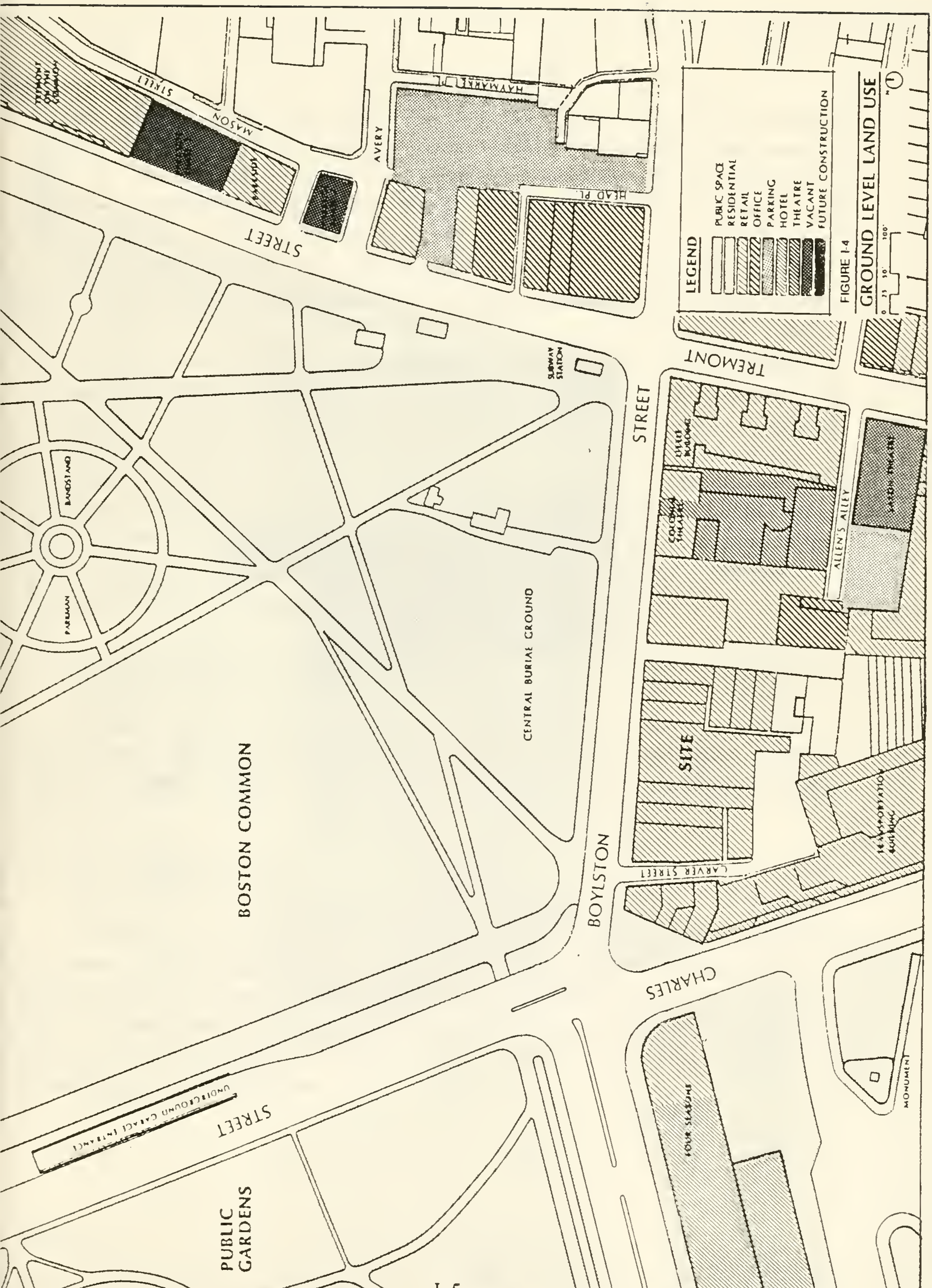
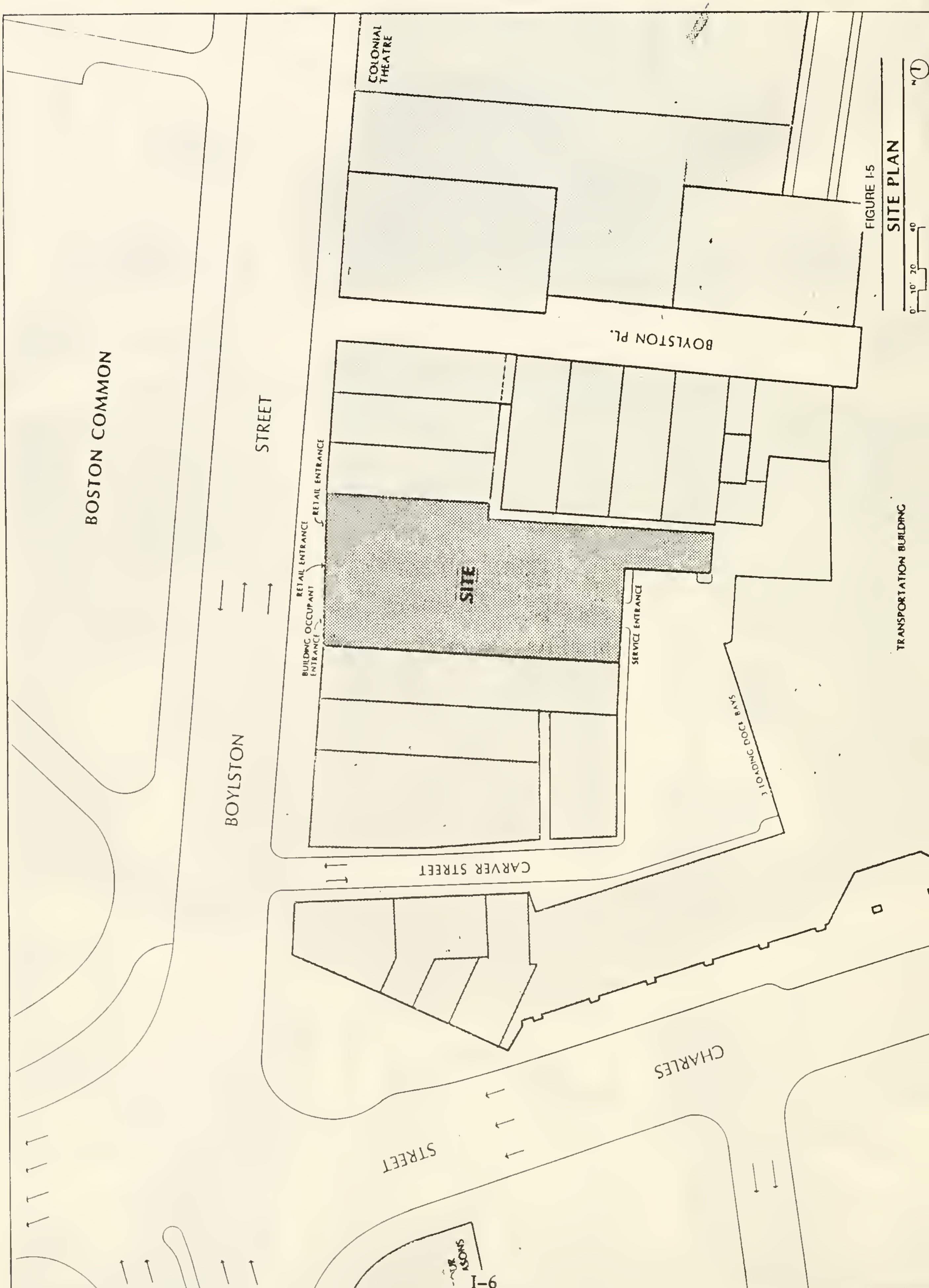


FIGURE I-4
GROUND LEVEL LAND USE
LEGEND
PUBLIC SPACE
RESIDENTIAL
RETAIL
OFFICE
PARKING
HOTEL
THEATRE
VACANT
FUTURE CONSTRUCTION
0 25 50 100'
N
BOSTON COMMON
PUBLIC GARDENS
CENTRAL BURIAL GROUND
BANDSTAND
PARKMAN
SUBWAY STATION
TREMONT STREET
BOYLSTON STREET
CHARLES STREET
CARVER STREET
MASON STREET
AVERY
HAYMARKET
HEAD PL.
ALLEN'S ALLEY
SITE
COLONIAL THEATRE
TRANSPORTATION BUILDING
FOUR SEASONS
MONUMENT
UNDERGROUND GARAGE ENTRANCE


BOSTON COMMON
BOYLSTON STREET
COLONIAL THEATRE
BOYLSTON PL.
SITE
RETAIL ENTRANCE
RETAIL ENTRANCE
BUILDING OCCUPANT ENTRANCE
SERVICE ENTRANCE
3 LOADING DOCK BAYS
TRANSPORTATION BUILDING
CARVER STREET
CHARLES STREET
FIGURE I-5
SITE PLAN
0' 10' 20' 40'
N

the rear linked by a circulation core, to preclude any slab effect. Principal materials proposed for the facades are brick and cast stone, representing a blending of the material palettes of the buildings to either side of the project. The building section shown in Figure I-6 shows the proposed building's height in relation to the State Transportation Building, and the different uses proposed for each level.

The dwelling units constitute the principal use of the building and occupy floors 3-13. There will be 37-41 units, depending on whether or not an option to duplex certain units is elected. The size of the residential units will range from approximately 1,350 sf up to 3,000 sf. A small health club will also be provided as an amenity to the residents of the development. The ground floor will be devoted to active, street oriented uses such as retail stores, and the second floor will contain either an extension of the ground floor use or leased office space. Two full levels below the Boylston Street grade and portions of three other levels (floors 3, 4 & 5) at the rear of the site are proposed for parking to be accessed by a valet operated car lift. Figures I-7 through I-11 show typical floor plans for various levels of the building. Table I-1 shows the space allocation for each use of the building. Figure I-12 shows the proposed building's roof plan as well as the roof plan of a floor area ratio (FAR) building of 8.0.

3.0 Summary of Impacts

The following sections summarize the potential benefits and impacts of the project. Since the only difference between the proposed FAR of 9.8 and an FAR of 8.0 is in the size of the interior courtyard, the environmental impacts of both designs are essentially the same.

3.1 Benefits

The proposed 144-150 Boylston Street development will have a positive impact on the general area, by revitalizing the three parcels which comprise the site. The two buildings which exist on the site are in various stages of disrepair (one has been gutted by fire), while the middle parcel is currently vacant. The proposed residential development will serve to enliven the area and is consistent with the City's goal of bringing residential development to the Boston Common area.

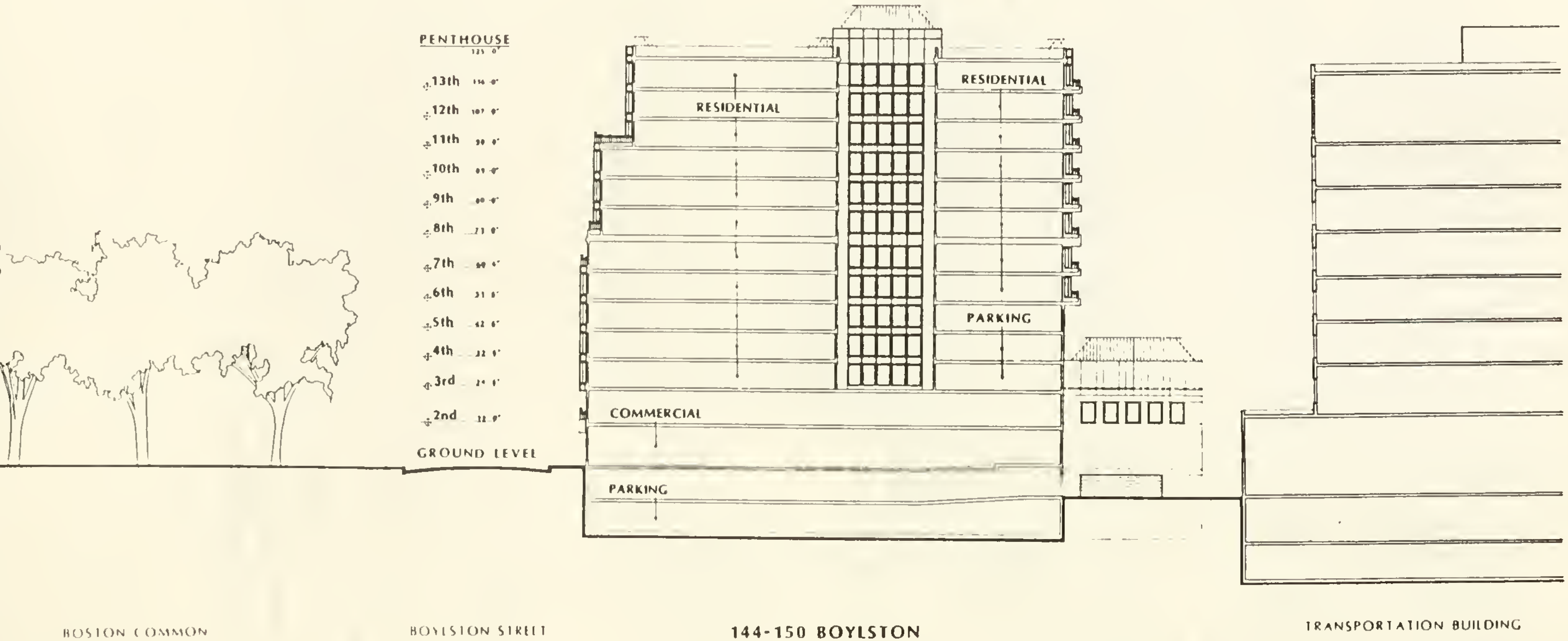


FIGURE I-6

BUILDING SECTION

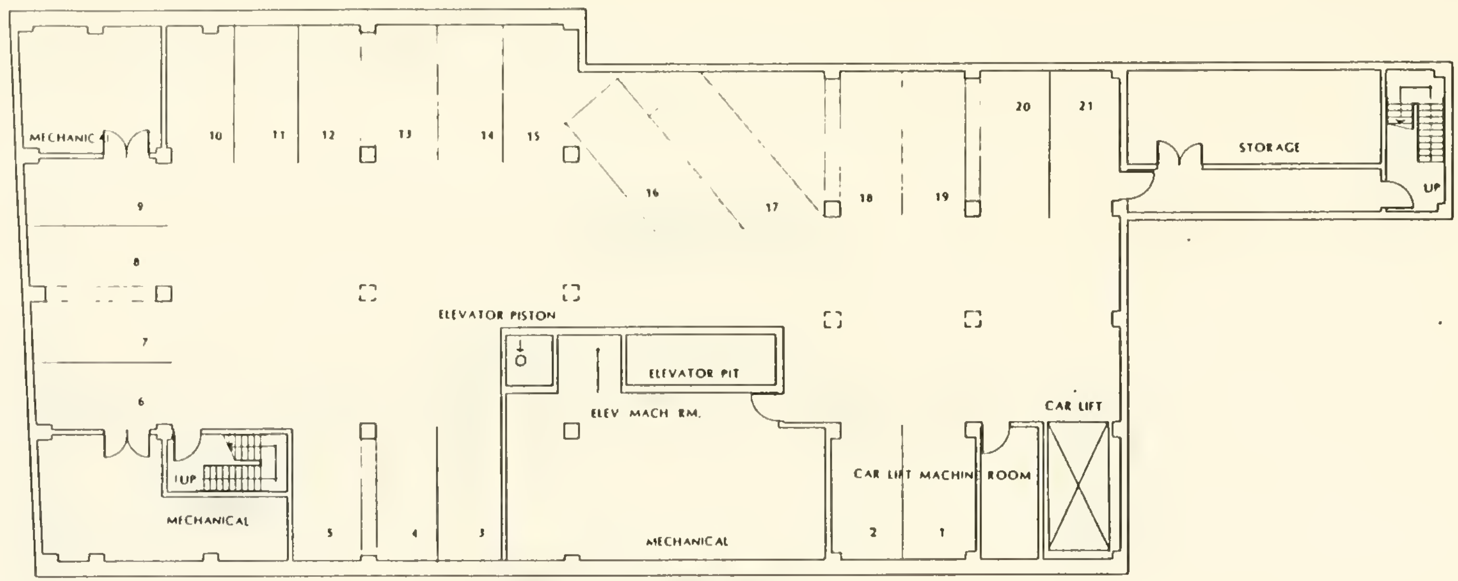


FIGURE I-7

LOWER GARAGE PLAN

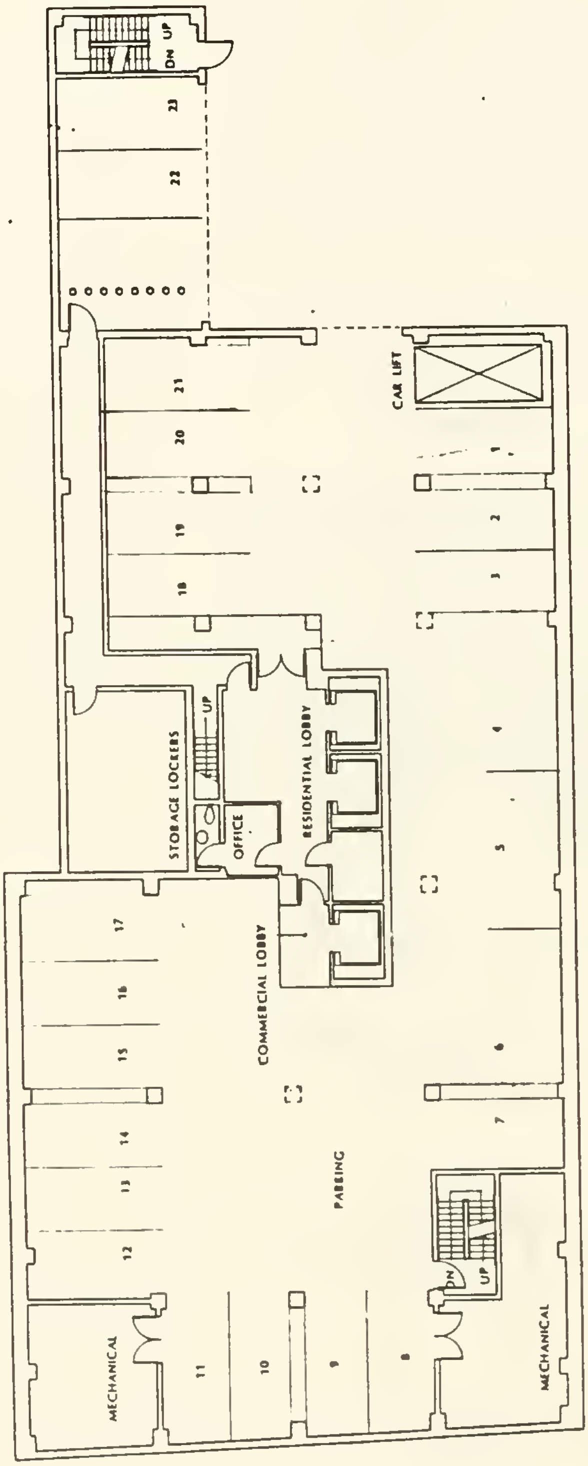


FIGURE I-8
UPPER GARAGE PLAN

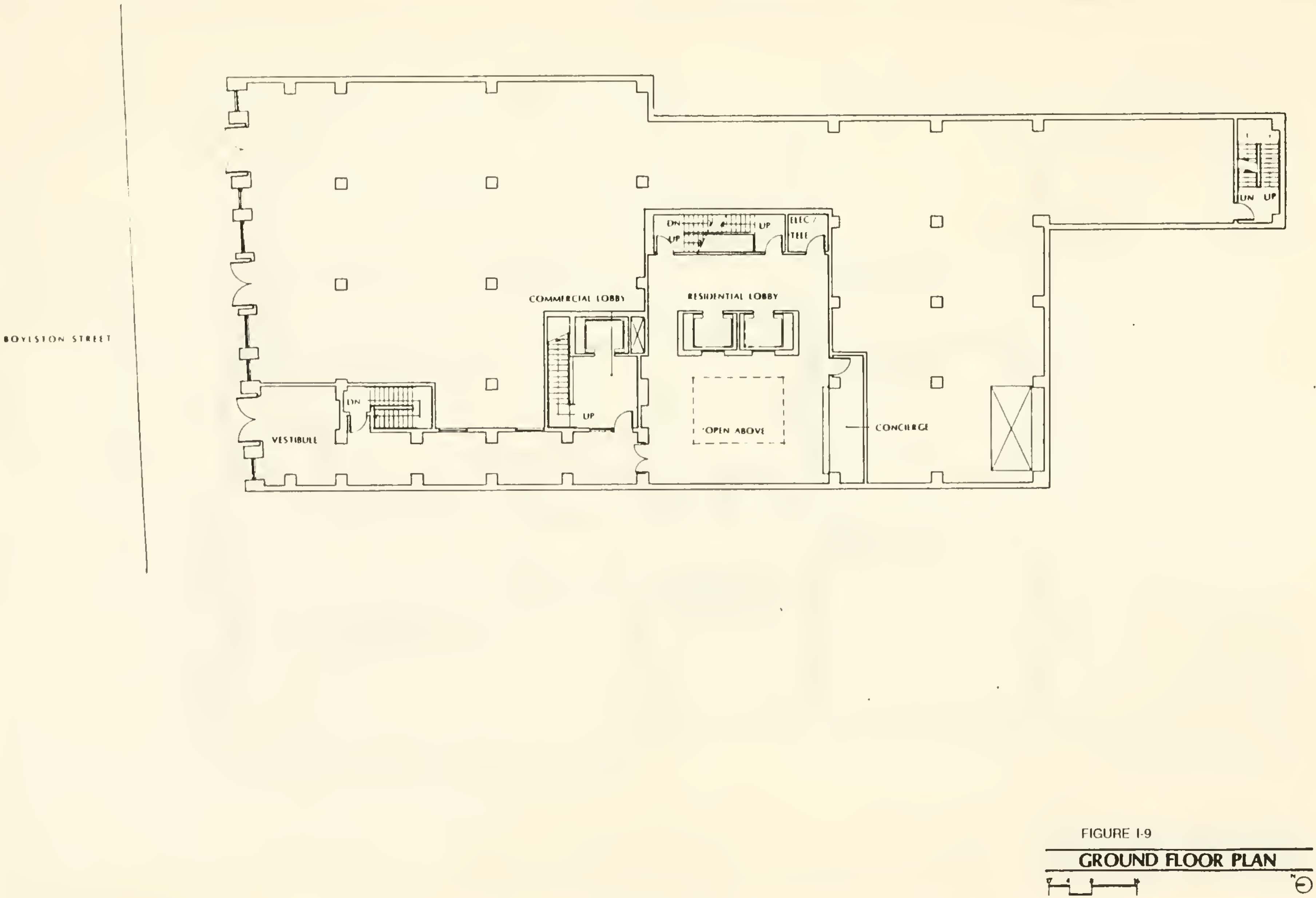


FIGURE I-9

GROUND FLOOR PLAN

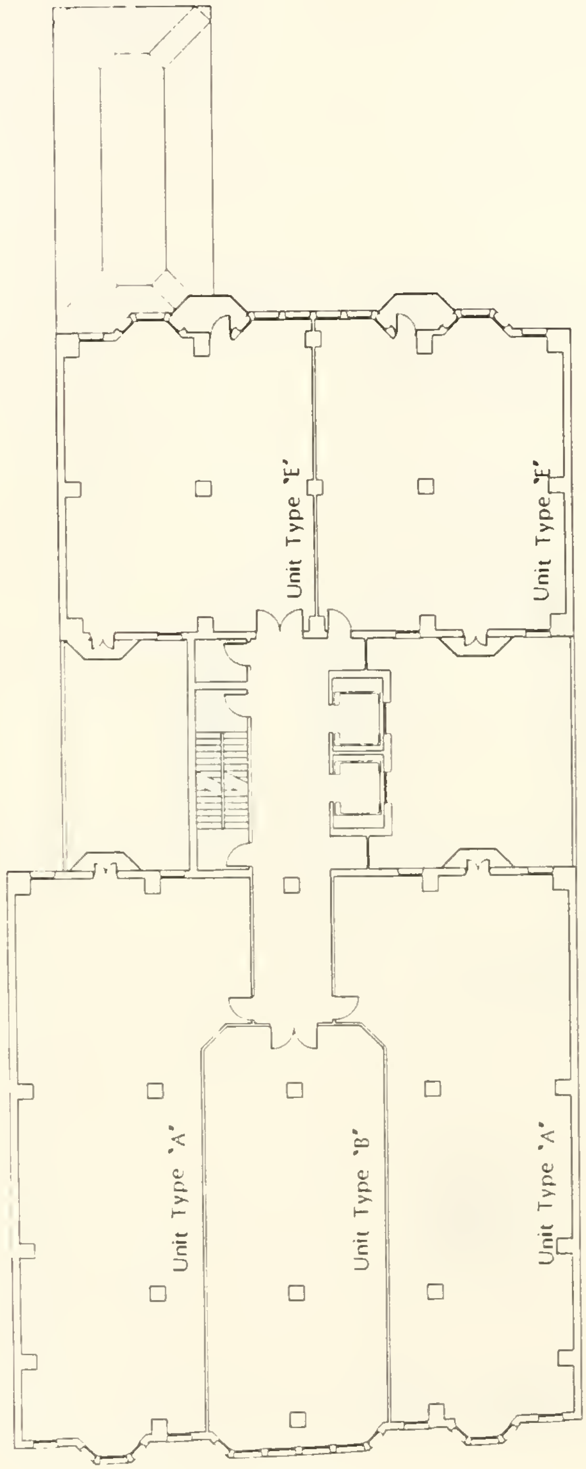


FIGURE I-10

TYPICAL LOWER FLOOR PLAN

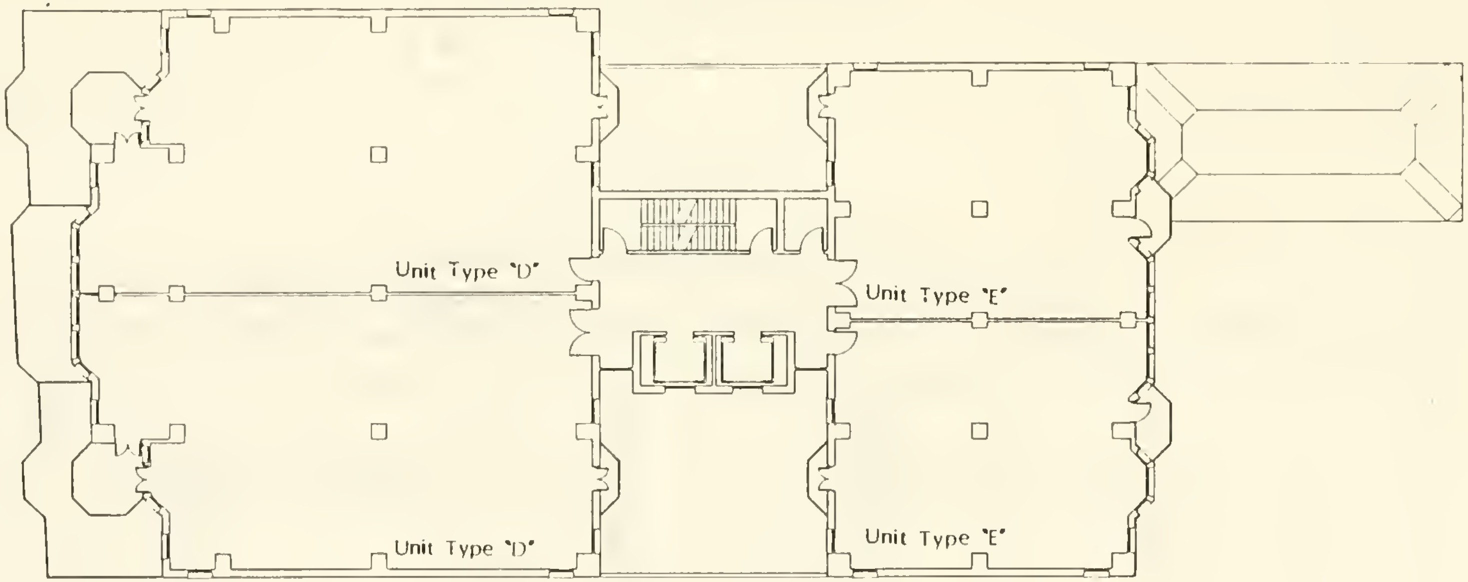


FIGURE I-11

TYPICAL UPPER FLOOR PLAN

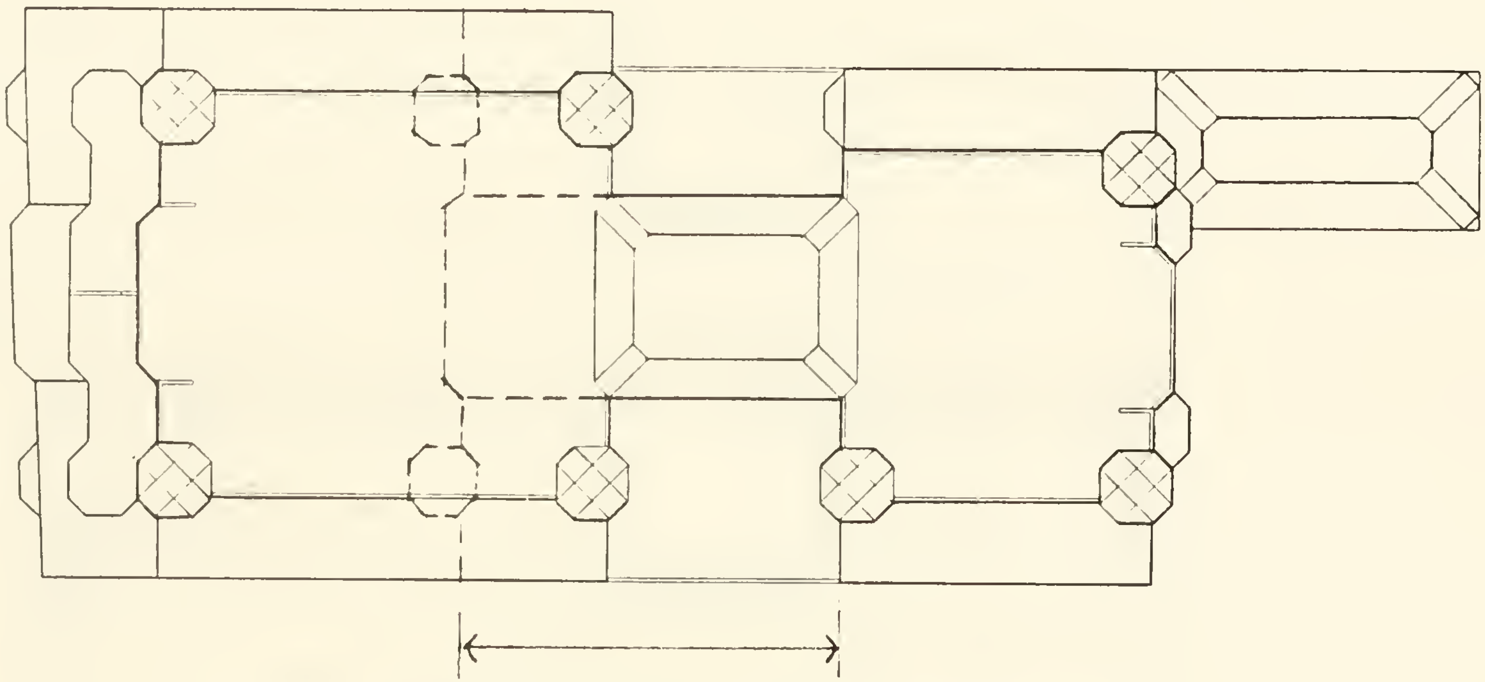


FIGURE I-12

ROOF PLAN

TABLE I-1

SPACE ALLOCATION BY USE

13 Story Scheme
37 Units (with duplex units at top)

BOYLSTON STREET CONDOMINIUMS
JULY 19, 1988
87003.3H/0992c.1

Estimated Area Tabulation (balconies and decks are excluded)

FLOORS	FLOOR AREA GROSS (S.F.) COMMERCIAL	RESIDENTIAL	HEALTH CLUB	PARKING	BUILDING SERVICE & STORAGE	LOBBY/* CIRCULATION	MECHANICAL & MACHINE RM	TOTAL*	FLOOR AREA EXCLUDED (S.F.)	FLOOR AREA, NET (S.F.) (FOR F.A.R. CALCULATIONS)	NUMBER PKG. SPACES	FAR
Lwr Garag				8,295		600	2,350	11,245	11,245		24	
Upr Garag				8,675	620	1,700	250	11,245	11,245		24	
Ground	8,150				200	2,840	55	11,245	90			
2nd	10,140					900	55	11,095	535			
3rd		5,710	1,200	2,060		1,080	55	10,104	470		7	
4th		5,710		2,643		880	55	9,288	470		7	
5th		5,710		2,643		880	55	9,288	470		7	
6th		8,415				880	55	9,350	220			
7th		8,215				880	55	9,150	220			
8th		7,755				700	55	8,510	220			
9th		7,755				700	55	8,510	220			
10th		7,755				700	55	8,510	220			
11th		7,405				700	55	8,160	220			
12th		5,635				700	55	6,390	220			
13th		5,635				700	55	6,390	220			
pent							800	800	800			
13 Stories	18,290	75,700	1,200	24,316	820	14,840	4,115	139,280	27,085	112,195	69 cars	9.77

* Includes area of elevators and car lift

Site - 11,482 sf

As a direct benefit to the City, the proponent will be contributing funds to a housing trust and the George Robert White Fund. In addition, the proponent is committed to restoring the sidewalk in front of the 144-150 Boylston Street building and is spearheading a drive to restore the pedestrian sidewalk along the entire block in cooperation with other property owners along Boylston Street.

3.2 Transportation

The transportation assessment included an evaluation of the impacts of the project on the transportation and pedestrian system. The proposed project is not expected to have a significant impact on the surrounding area. The project will generate an average of 158 daily vehicle trips in and out of the site with only 15 of these occurring during the PM peak traffic hour. These added vehicles will have little effect on the traffic network surrounding the site. The site-generated traffic is also not expected to exert impact on pedestrian activities on the sidewalk along Boylston Street, since the number of vehicles generated, particularly during the peak traffic hour, are very low.

Access to the site will be via Carver Street to the parking garage entrance at the rear. Adequate space exists in the alley at the garage entrance for maneuvering of automobiles as well as delivery trucks. An average of three trucks are expected to be making deliveries during any given day.

The proposed garage will have 69 parking spaces. These spaces will be available for use by residents, residential visitors, and retail employees. In order to reduce the number of vehicle trips to the site, the residents and other tenants will be encouraged to use public transit, which is within easy walking distance to the development.

3.3 Wind

A wind-tunnel test was performed to evaluate the impact of the 144-150 Boylston Street project on pedestrian wind speeds within 1800 feet of the site. A 1:350 scale model of the project and the surrounding city was installed in a boundary-layer wind tunnel capable of simulating atmospheric winds over the site. Flow visualization studies were conducted using smoke to make the wind visible, to evaluate relative wind speeds, and to identify differences between the Build and No-Build configurations. The flow visualization results showed no adverse impact of the building on wind speeds in any area near the building site.

3.4 Shadows

Most of the net new shadows associated with the proposed building will be limited to Boylston Street and its sidewalks and the southern portion of the Boston Common, particularly the Central Burial Ground since it is immediately north of the site across Boylston Street. The longest shadows will be cast during December, mostly on the Boston Common. December, however, is not a time of heavy use for the Common, with pedestrians being primarily in transit. In addition, this new shading occurs at a time when extensive existing shadows already intrude on the Boston Common. During spring and fall, some new shadows will be cast on the Common and its walkways, but these are minor compared to the shadows which are already cast by the existing buildings surrounding the area.

Vegetation in the affected area is currently shaded by existing buildings and mature trees during the early and late portions of the growing season. The proposed building will result in only a slight increase in total shade. Because of this minor increase, there will be no significant impacts on the Boston Common vegetation associated with this project.

3.5 Air Quality

The air quality analysis at the two intersections analyzed for this study (Boylston/Tremont and Boylston/Charles) demonstrated no violation of the one-hour carbon monoxide (CO) National Ambient Air Quality Standards (NAAQS) for any case. The air quality analysis showed that the additional vehicles of the project at these intersections will have virtually no effect on the CO levels in the area.

Eight-hour CO impacts will also not be affected by the project. The analysis, however, shows violations of NAAQS at some of the receptors. The receptor at Brighams indicated the highest predicted level of 12.5 parts per million (ppm) under the existing case. This level is 3.5 ppm higher than the eight-hour standard. In 1990, this level will decrease to 10.6 ppm, 1.6 ppm higher than the eight-hour standard. These exceedences are not due to the 144-150 Boylston Street project.

No exceedences of the NAAQS are predicted in any case for the receptors located at the Boylston Place cafe and the proposed building's entrance. The highest predicted one-hour CO level is 14.2 ppm at the front door of the project under the existing case. The highest predicted eight-hour CO level is 6.4 ppm in the existing case at the same receptor location, also below the eight-hour standard of 9 ppm.

Currently, the City of Boston is in the process of optimizing, through computer operated traffic flow monitors, approximately 250 signals downtown, including the project study area. Completion of this program is expected in 1990. Computer driven signal timings, which will be based on demand, will improve traffic flow over peak one- and eight-hour periods in the project area. During eight-hour periods, when the only violations of the NAAQS for CO were predicted, continual monitoring of traffic conditions and appropriate adjustments to signal timings under this program should provide significant potential air quality benefits. In addition, this program will serve to reduce CO background levels as general flow in the downtown area will improve.

3.6 Geotechnical

There are no soft or compressible soil formations below the project site to initiate a foundation settlement or a stability problem associated with the proposed building. Groundwater levels at the project site, as observed through observation wells, are below the bottom of the proposed foundation excavation. Foundation excavation will involve removal of the clean miscellaneous fill soils blanketing the mid-portion of the project site and will have no negative environmental impact. Since the groundwater level is below the bottom of the foundation excavation, no construction dewatering is anticipated. That is, both during construction and the subsequent service life of the building, groundwater levels will not be affected by the building foundation. There will be no discharge to the groundwater from the building.

Foundations of the existing structures adjacent to the project site will be secured prior to proposed foundation excavation. Similarly, sidewalks along Boylston Street and Carver Street will be protected against settlements and lateral movements by braced temporary lateral support systems.

3.7 Noise

The project area and much of the inner city areas experience fairly high noise levels typical of an urban environment. The average day-night noise levels (L_{dn}) in the project area are predicted to be in the area of 67 to 68 dBA, slightly higher than HUD's noise criteria of 65 dBA or less, for residential developments. The project area is a fairly lively environment, both during the day and evening hours. However, these same characteristics also make the project's location attractive as a residential development.

The 144–150 Boylston Street proponent will incorporate into the building's design noise attenuation measures. This will include installing double-glazed windows and appropriate amounts of insulation in the walls to reduce the noise levels experienced by future residents of the proposed development.

3.8 Rodent Control

The project proponent will have contracted with a licensed exterminator prior to beginning any work at the project. Rodent extermination will be carried out before, during, and at the completion of all foundation work for the proposed project, in compliance with the City and State requirements.

3.9 Historic Resources

The project site is located within the Piano Row Historic District, which is part of the larger Theater Multiple Resource Area. The two buildings currently on the site will need to be demolished. The Boston Landmarks Commission ratings for these buildings are Category 4 (Notable) for the 144 Boylston Street building and Category 5 (Minor) for the 150 Boylston Street building. The Commission has indicated that demolition of these buildings will not be a problem. The project architects are continuing to develop a building design which aims at achieving an architectural solution which is compatible with the surrounding structures in the historic district.

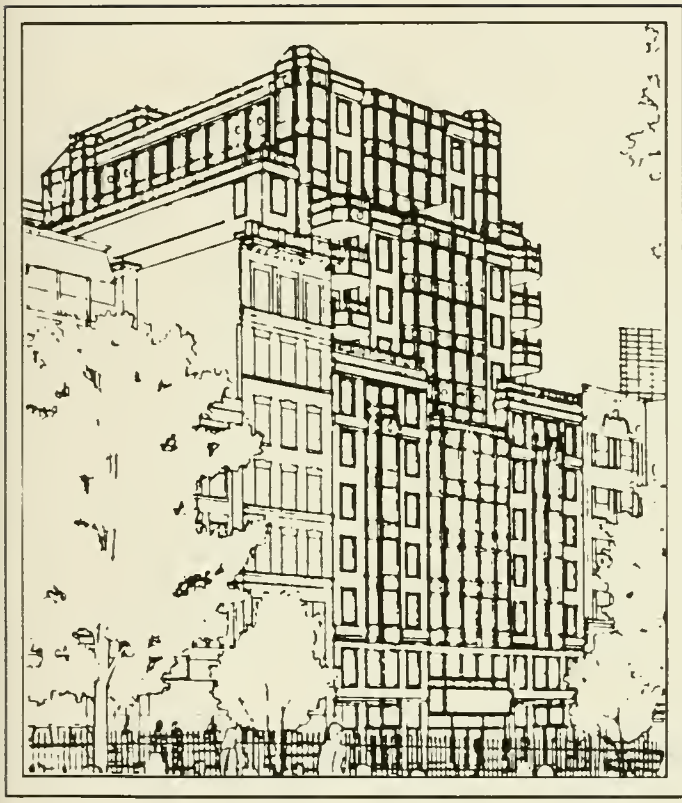
3.10 Infrastructure

The average daily sewage generation was calculated to be about 11,700 gallons per day (gpd) for the proposed project. Because the majority of the proposed space is for residential use, peak generation rates are expected to occur during early morning or early evening hours. A peak value of 35,180 gpd is projected. Based on the capacity analysis conducted and the sewage generation information developed, the prescribed sanitary sewer route will be able to accept this flow for transfer to the Deer Island Treatment Facility without incident.

Storm water will be directed to the 15-inch combined sewer in Boylston Street which currently handles storm water discharges from the area without difficulty. Because there will be no net increase in storm water flows from the site, there will be no change in impact on the storm drain system.

The maximum flow water demand for domestic use and cooling water makeup is calculated to be 69 gallons per minute (gpm). The Southern Low system has sufficient capacity to meet this demand. The test results reported for the Southern Low system in the project vicinity show a capacity of 3,600 gpm at 47 psi. The fire flow requirement of 1500 gpm can adequately be satisfied by the Southern High system. Fire flow/hydrant test data show a capacity of 4,890 gpm at 82 psi for a location near the proposed development.

The proposed development will most likely satisfy all of its energy and power requirements electrically. In addition to the typical electric power uses, hot water and space heating will also be electrical. The energy efficient space heating-cooling system to be specified will use a continuous water loop throughout the structure as the heat sink or source with individual heat pumps located in each unit or use area to provide heating or cooling. This type of system incorporates an important measure of conservation by providing a mode for the balancing of heating and cooling needs throughout the proposed structure. In addition to the energy efficient heating-cooling system, the proponent plans to incorporate other energy conservation procedures. These efforts are designed to comply with the requirements contained in the recently revised (July 1, 1988) Article 20, Energy Conservation, of the Massachusetts State Building Code.



II. SCOPING DOCUMENTS

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Boston Redevelopment Authority Scoping Determination
April 27, 1988

Boston Landmarks Commission Letter
April 15, 1988

TON
EVELOPMENT
HORITY

ond L. Flynn

en Coyle

y Hall Square
MA 02201
2-4300

April 27, 1988

Mr. Mark Gladstone
Fox Properties
P. O. Box 29
47 Winter Street
Weymouth, MA 02189

Dear Mr. Gladstone:

I appreciate your interest in the redevelopment of 144-150 Boylston Street. Attached is a Scoping Determination that sets forth those aspects of the project which must be studied, analyzed and, where necessary, mitigated. In addition, the Scoping Determination lists background information which must be provided. These components should be addressed and included in your Draft Project Impact Report.

As you know, your property is located within the Downtown Interim Planning Overlay District (IPOD). Under the current IPOD guidelines, the as-of-right zoning for the building is a Floor Area Ratio ("FAR") of 8 and a maximum height limitation of 125'. Article 27D of the Boston Zoning Code which sets forth specific goals and objectives for the IPOD district, provides for planning which encourages height and massing consistent with the surrounding area and is architecturally compatible with the surrounding subdistrict.

In addition, in accordance with Article 16-6(d) of the Boston Zoning Code, structures located on Boylston Street from Tamworth Street to Park Square shall not exceed 130' in height. As indicated in the attached document, we require the submission of materials for a proposal that conforms with the height and massing requirements set forth in the IPOD and in Article 16-6(d) of the Boston Zoning Code.

C27/09

Additional information may be required during the course of our review of the project. Should you or your consultants have any questions concerning these matters, please contact either Cindy Schlessinger or Nancyellen Hayes of my staff. I look forward to working with you and reviewing your proposal.

Sincerely,

William D. Whitney
Acting Assistant Director of
Urban Design and Development

cc: William J. Smith, Esq.
Richard Donnelly

SUBMISSION REQUIREMENTS FOR DRAFT PROJECT IMPACT REPORT (DPIR)

In addition to full-size scale drawings, 10 copies of a bound booklet containing all submission materials reduced to size 8½ x 11, except where otherwise specified, are required. For projects to be reviewed by the Boston Civic Design Commission, 15 booklets containing the applicant information and the design submission materials are required. Information submitted should be based on a height limit of 125'.

I. GENERAL INFORMATION

1. Applicant Information

A. Development Team

1. Names

a. Developer (including description of development or Chapter 121A entity)

b. Attorney

c. Project consultants

2. Business address and telephone number for each

3. Designated contact for each

4. Description of current or formerly-owned developments in Boston

B. Legal Information

1. Legal judgements or actions pending concerning the proposed project

2. Status of any pending litigation with regard to the acquisition, disposition, ownership, or development of real estate to which any of the principals involved (holders of an equity interest) in this project are a party which have been filed in any court in the Commonwealth of Massachusetts and the dispostion of any litigation initiated in the Commonwealth which has been settled or tried to judgement in the last five years.

3. History of tax arrears on property owned in Boston by development team

4. Property Title Report including current ownership and purchase options of all parcels in the development site

2. Financial Information
(See Appendix 1 for sample forms.)

A. Full disclosure of names and addresses of all financially involved participants and bank references

B. Nature of agreements for securing parcels not owned by prospective developer

C. Development Pro Forma

D. Operating Pro Forma

E. Sales Pro Forma

3. Project Area

A. Description of metes and bounds of project area

4. Relocation Information

A. Statement by applicant concerning applicability to project of any Federal or State Relocation Regulations, and Citation of Regulations believed applicable

B. For projects not covered by federal or state programs containing relocation regulations, the following information:

1. Number of units in building(s) to be demolished or vacated

2. Number of occupied units, by type, per building

3. Tenure of occupants (owner/tenant/sub-tenant)

4. Name and address of each occupant (owner or prime tenant)

5. Information on size and monthly costs:

Non-residential - gross square feet of area, number of floors, including ground floors and monthly rent, indicating included utilities

6. Length of occupancy of current occupant in unit (and building if greater)

7. Estimate of the total number of small businesses

8. Number, if any, of minority households or businesses displaced

9. Net increase or decrease in number of units:

Total number of housing units proposed

5. Employment Plan

Boston Jobs Policy requires that publicly-assisted and large-scale private commercial projects hire Boston residents, minorities, and women for construction jobs for 50, 25, and 10 percent respectively of the person-hours worked. In addition, developers may be requested to submit permanent employment plans intended to meet a goal that the profile of permanent employees in the building include Boston residents (50 percent), minorities (30 percent), and women (50 percent). Submission materials include the following:

A. Estimated number of construction jobs
B. Estimated number of permanent jobs
C. Plan for meeting Boston Resident Construction Jobs Standards
D. Plan for meeting Boston Resident Permanent Jobs Standards
E. Plan for meeting Minority Business Employment Goals of City contracts or state and federal regulations and policies

6. Public Benefits

A. Development Impact Project exaction, specifying amount and method of linkage contribution (housing payment or housing creation)

B. Increase in tax revenues, specifying existing and estimated future annual property taxes

C. Childcare plan

D. Other public benefits

7. Regulatory Controls and Permits

A. Existing zoning requirements, calculations, and any anticipated zoning requests

B. Anticipated permits required from other local, state, and federal entities with a proposed application schedule

C. For structures in National or Massachusetts Register Districts or sites individually listed on the National or Massachusetts Register of Historic Places, duplicates of parts I and II of the certification documents and applicable correspondence and permits

D. For projects requiring compliance with the Massachusetts Environmental Policy Act (MEPA), copies of the Environmental Notification Form, Certificate of the Secretary of Environmental Affairs, and Environmental Impact Report, if required

E. Other applicable environmental documentation

8. Community Groups

A. Names and addresses of project area owners, displacees, abutters, and also any community groups which, in the opinion

of the applicant, may be substantially interested in or affected by the proposed project

B. A list of meetings proposed and held with interested parties

9. <u>Affirmative Housing Plan</u>

Applicants for city-owned land; city, state, or federal funds administered by a city-agency; or zoning relief to construct housing may be required to submit an Affirmative Housing Plan and to adhere to fair housing requirements outlined in Appendix 4. The plan should include the following:

A. Description of affirmative marketing techniques

B. Description of owner/tenant selection process

C. Proposed owner/tenant profile indicating number of units dedicated to community residents, minorities, female-headed households, and low-moderate income people.

II. <u>TRANSPORTATION COMPONENT</u>

1. Parking

A. Number of spaces provided indicating public and private allocation

B. Reduction in parking from previous use of site

C. Proposal's impact on demand for parking

D. Parking plan, including layout, access, and size of spaces

E. Evidence of compliance with City of Boston parking freeze requirements

2. Loading

A. Number of docks

B. Location and dimension of docks

3. Access

A. Size and maneuvering space on-site or in public right-of-way

B. Access, curb cuts, and/or sidewalk changes required

4. Vehicular Traffic

A. Project vehicular traffic demand and generation (daily and peak-hours) and distribution

5. Public Transportation

A. Location and availability of public transportation facilities

B. Measures to encourage use of public transportation

6. Pedestrian Circulation

A. Connections to public transportation station stops

B. Effect on pedestrian flows of project parking and servicing entrances and exits

7. Access Plan

A. Measures to manage parking demand and optimize use of available parking spaces, including:

- o Proposed rate structures(s) for commercial spaces
- o Ride-sharing incentives and information dissemination
- o Set-asides for high-occupancy-vehicles: number and location
- o Set-asides for after morning commuter peak (usually 9:30 or 10:00 a.m.)

B. Measures to encourage public transportation use, including:

- o Mass transit information dissemination
- o MBTA pass sales and subsidies
- o Direct station links or pedestrian connections

C. Measures to reduce peaking, including:

- o Encouragement of f exible work hours
- o Restrictions on service and good deliveries

D. Measures to mitigate construction impacts, including:

- o Time and routes of truck movements
- o Storage of materials and equipment
- o Worker parking and commuting plan

E. Monitoring and reporting measures

III. ENVIRONMENTAL PROTECTION COMPONENT

1. Wind

A qualitative analysis of the potential wind impacts of the proposed building at the pedestrian level shall be required for the Draft Project Impact Report. This analysis shall determine potential pedestrian level winds adjacent to and in the vicinity of the project site and shall identify any areas where wind velocities are expected to exceed acceptable levels, including the Authority's guideline of

an effective gust velocity of 31 mph not to be exceeded more than 1% of the time.

Particular attention shall be given to public and other areas of pedestrian use, including, but not limited to, project entrances, the Boston Common, the Boylston Street sidewalks, and Boylston Place.

For areas where wind speeds are projected to exceed acceptable levels, measures to reduce wind speeds and to mitigate potential adverse impacts shall be identified.

Should the qualitative analysis indicate the possibility of excessive pedestrian level wind speeds, additional studies, including wind tunnel testing, may be required for the Final Impact Report.

2. Shadow

A shadow analysis shall be required for existing and build conditions for the hours 9:00 a.m., 12:00 noon, and 3:00 p.m. for the vernal equinox, summer solstice, autumnal equinox, and winter solstice. It should be noted that due to time differences (daylight savings vs. standard), the autumnal equinox shadows would not be the same as the vernal equinox shadows and therefore separate shadow studies are required for the vernal and autumnal equinoces.

Shadow analysis also are to be conducted for 10:00 a.m., 11:00 a.m., 12:00 noon, 1:00 p.m., and 2:00 p.m. for October 21 and November 21.

The shadow impact analysis must include net new shadow as well as existing shadow and must clearly show the incremental impact of the proposed building.

Particular attention shall be given to existing or proposed public open spaces and major pedestrian areas, including, but not limited to, the Boston Common, the Central Burying Ground, and sidewalks along Boylston Street.

The impact of additional shadowing on the Boston Common vegetation also shall be analyzed, with appropriate documentation.

Design or other mitigation measures to limit or minimize any adverse shadow impact shall be identified.

3. Air Quality

An evaluation of ambient carbon monoxide levels in the vicinity of the project site shall be required to determine conformance with the National Ambient Air Quality Standards established by the U.S. Environmental Protection Agency.

A description of the garage exhaust system, including location and specifications, and an analysis of the impact on pedestrian level air quality from operation of the exhaust system shall be required.

Measures to avoid any violation of air quality standards shall be described.

4. Geotechnical Impact

An analysis of existing sub-soil conditions, potential for ground movement and settlement during excavation, and potential impact on adjacent buildings and utility lines and the Boylston Street subway tunnel shall be required. This analysis shall also include a description of the foundation construction methodology, the amount and method of excavation, and measures to prevent any adverse effects on adjacent buildings and utility lines.

The project may include up to four levels of underground parking, in which case excavation below the existing water table would be required. Therefore, an analysis shall be required of the impact of foundation construction on the maintenance of groundwater levels and on foundation supports (e.g., wood piles) of adjacent structures. Measures to ensure that groundwater levels will not be lowered during or after construction shall be described.

5. Noise

An evaluation of ambient noise levels shall be required to determine conformance with the Design Noise Levels established for residential developments by the U.S. Department of Housing and Urban Development. Should excessive ambient noise levels exist, mitigation measures to reduce these levels to acceptable levels shall be described.

6. Rodent Control

An analysis of the impact of project construction on rodent populations and a description of the proposed rodent control program and compliance with applicable City and State regulatory requirements shall be required.

IV. URBAN DESIGN COMPONENT

In order to determine that the Proposed Project: (a) is architecturally compatible with surrounding structures; (b) exhibits an architectural concept that enhances the urban design features of the subdistrict in which it is located; (c) augments the quality of the pedestrian environment; and (d) is consistent with any established design guidelines that exist for the area in which the Proposed Project is located, the Authority will require submission of the following:

1. Summary of proposed development with written description of program elements and space allocation for each element, and proposed schedules for review and development.

2. Neighborhood plan and sections at an appropriate scale (1" = 50' or larger) showing relationships of the proposed project to the neighborhood's:

A. massing

B. building height

C. scaling elements

D. open space

E. major topographic features

F. pedestrian and vehicular circulation

G. land use

3. Black and white 8"x10" photographs of the site and neighborhood

4. Eye-level perspective (reproducible line drawings) showing the proposal in the context of the surrounding area from vantage points indicated on the attached location plan

5. Site sections at 1" = 20' or larger showing relationships to adjacent buildings and spaces including Boston Common and the State Transportation Building

6. Site plan at an appropriate scale (1" = 20' or larger) showing:

A. General relationships of proposed and existing adjacent buildings and open space

B. Open spaces defined by buildings on adjacent parcels and across streets

C. General location of pedestrian ways, driveways, parking, service areas, streets, and major landscape features

D. Pedestrian, handicapped, vehicular and service access and flow through the parcel and to adjacent areas

E. Survey information, such as existing elevations, benchmarks, and utilities

F. Phasing possibilities

G. Construction limits

7. Massing model at 1" = 40' for use in the Authority's downtown base model

8. Drawings at an appropriate scale (e.g., 1" = 8') describing architectural massing, facade design and proposed materials including:

A. Building and site improvement plans

B. Elevations in the context of the surrounding area including elevations of existing buildings along the entire Piano Row block

C. Sections showing organization of functions and spaces

9. Preliminary building plans showing ground floor and typical upper floor(s)

10. Proposed schedule for review and development

V. HISTORIC RESOURCES COMPONENT

1. Description of the project site location in proximity to a National or Massachusetts Register site or district or Landmark designated by the Boston Landmarks Commission

2. Identification of Boston Landmarks Commission ratings for existing buildings.

3. Possible effects to the National or Massachusetts Register site or district or a Landmark designated by the Boston Landmarks Commission

VI. INFRASTRUCTURE SYSTEMS COMPONENT

1. Utility Systems

A. Estimated water consumption and sewage generation from the project

B. Description of the capacity and adequacy of water and sewer systems and an evaluation of the impacts of the project on these systems

C. Identification of measures to conserve resources, including any provisions for recycling

2. Water Quality

A. Description of impacts of the project on the water quality of Boston Harbor or other water bodies that could be affected by the project, if applicable

B. Description of mitigation measures to reduce or eliminate impacts on water quality

C. Energy

1. Description of energy requirements of the project and evaluation of project impacts on resources and supply.

BOSTON
TRANSPORTATION
DEPARTMENT

ONE CITY HALL PLAZA / ROOM 721
BOSTON, MASSACHUSETTS 02201
(617) 725-4680

DATE: April 22, 1988

TO: Cindy Schlessinger
FROM: Andrew McClurg
RE: 144-150 Boylston PNF

This 53-unit condominium project is located in a very sensitive area with regard to traffic circulation. Consequently, issues related to trip generation and parking must be carefully examined. Among the questions which the PIR must answer are:

- Parking. The PNF is not definite on the number of parking spaces to be provided. This must be clarified, and the allocation of spaces between residential and other uses must be stated. The method by which residents' right to use parking spaces will be established must be detailed, and ways of guaranteeing that freeze-exempt spaces are not used by commuters must be discussed. Visitor spaces must be provided. Control mechanisms, such as valet parking or card-operated gates, should be described. The operation of the car elevator must be described in detail, including such issues as the amount of time necessary to park cars ("through-put").

- Loading. Truck deliveries will be difficult in this area. A comprehensive plan for limiting and scheduling deliveries, both during the lease-up period and afterward, must be provided.

- Traffic mitigation. The developer must indicate the measures which will be employed to encourage "non-car-ownership" and "non-car-use" among project residents, employees and patrons.

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ity of Boston
he Environment
epartment

ston City Hall/Room 805
ston, Massachusetts 02201
7/725-3850

April 15, 1988

Ms. Cindy Schlessinger
Boston Redevelopment Authority
Boston City Hall
Boston, MA 02201

Dear Cindy:

The staff of the Boston Landmarks Commission has reviewed the Project Impact Report for 144-150 Boylston Street submitted by FOX/LDD Partners of Boylston Street Limited Partnership. The report is accurate in its factural presentation concerning historic resources.

The staff would like to add the following comments regarding the design of the project:

1. The staff does not anticipate any problems with the demolition of the buildings at 144 and 150 Boylston Street.

2. The staff is concerned about the height of the proposed building and strongly urges a reduction to a height that is similar to the Colonial Theatre and the Transportation Building.

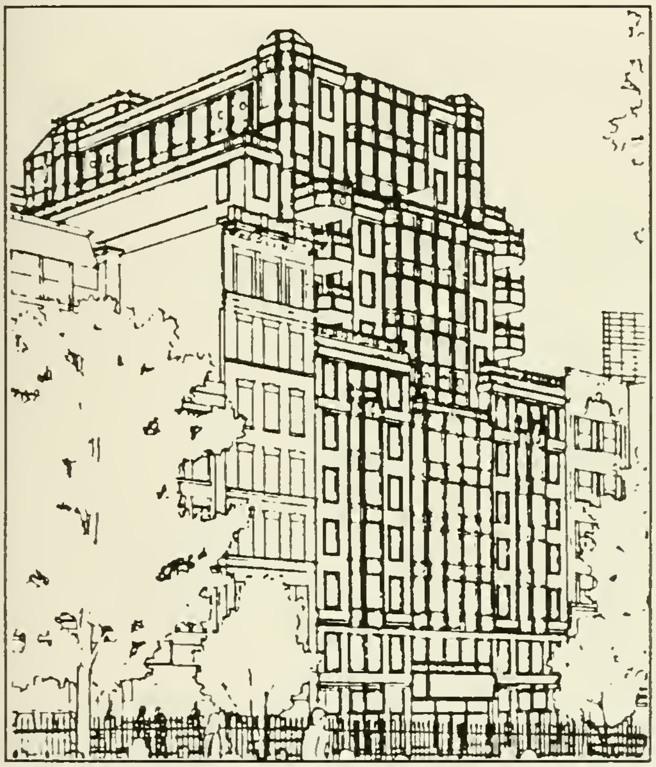
Thank you for the opportunity to comment.

Sincerely,

Judith B. McDonough

Judith B. McDonough
Executive Director
Boston Landmarks Commission

cc:Downey
MHC
BRA
[illegible]1482E



III. GENERAL INFORMATION

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1.0 Applicant Information

1.1 Development Team

1) Fox/LDD Partners of Boylston Street is a duly recorded Massachusetts Limited Partnership wherein Robert Fox of Fox Properties, Inc., 47 Winter Street, Weymouth, Massachusetts, is the Managing General Partner. The remainder of the General Partners are Richard Donnelly and John S. Dennehy, Jr., of LDD Corporation. The legal address and telephone number for the development entity is 47 Winter Street, Weymouth, Massachusetts, and (617) 337-5420.

2) The attorneys for the entity are as follows:

William J. Smith, Esq.
McCormack & Putziger
265 Franklin Street
Boston, Massachusetts 02110
(617) 439-4100

Mark J. Gladstone, Esq.
Mark J. Gladstone, P.C.
63 Winter Street
Weymouth, Massachusetts 02189
(617) 337-5660

3) The project consultants for the entity are as follows:

Architects

Jung/Brannen Associates, Inc.
177 Milk Street
Boston, Massachusetts 02109
(617) 482-2299
Ms. Sandra Shwalb

Geotechnical Consultants

Haley & Aldrich, Inc.
58 Charles Street
Cambridge, Massachusetts 02141
(617) 494-1606

Environmental Consultants

HMM Associates, Inc.
336 Baker Avenue
Concord, Massachusetts 01742
(508) 369-0119
Mr. Mitchell L. Fischman

4) Robert Fox, the Managing General Partner of this project, is an officer of Tontine Crescent Associates, the corporate developer of a project located in Charlestown, known as Tontine Crescent, consisting of residential condominiums, a commercial building and parking garage, which project has been permitted and developed, and is in the advance stages of sales for the residential condominiums. Fox Properties, Inc., an entity owned exclusively by Robert Fox, is presently the construction and marketing manager of Tontine Crescent, responsible for all areas of supervision of development and management for that development.

1.2 Legal Information

1) Presently, there are no known legal judgments or actions pending concerning the proposed project, nor are the developers aware of any facts at the present time which would give rise to the pendency of any such action. However, the developers have under binding Purchase and Sale Agreement with the George Robert White Fund as Sellers, an Agreement to purchase the middle parcel of the three parcels necessary to advance this project. The Purchase and Sale Agreement with the George Robert White Fund is in the process of being reviewed by the Attorney General's Office, Public Charities Division. Once the details of the sale are approved by the Attorney General, the developer is advised that Probate Court approval will be needed to

effectuate a full, complete transfer of marketable title. Based on information available to the developer from conferences with the Trust Office of the City of Boston, Boston Corporation Counsel and the Attorney General's Office, it is expected that this process will be completed without any objection or difficulty insofar as the ratification of the Agreement is concerned.

2) Except as provided above concerning the Probate Court action, which is anticipated to be instituted to ratify the conveyance to the developers of the Trust Fund parcel, there are no known pending litigation matters regarding the acquisition, disposition, ownership or development of real estate in which any of the principals in this project are involved which have been filed in any Court of the Commonwealth of Massachusetts and which have been settled or tried to judgment in the last five years.

3) There is no history of tax arrears on property owned in Boston by the development team.

4) The project to be advanced consists of three separate and distinct parcels of real estate. The first parcel consists of the property presently located at 144 Boylston Street previously occupied by the Mansfield Beauty Academy. The second parcel is the property having a present address of 150 Boylston Street, which property was the former address of the Devon On The Common restaurant, and most recently was owned by Weylu's Restaurant. Both of the two parcels referenced are presently owned by Fox/LDD Partners of Boylston Street, which partnership took title to these properties in March of this year.

5) With regard to the third parcel of real estate necessary to complete the land acquisition for this project, there is a parcel of vacant land between the two existing buildings referenced above, which parcel is owned by the George Robert White Fund, administered through the Trust Department of the City of Boston. The developers of this

project presently have this third parcel bound under a Purchase and Sale Agreement wherein said property is being purchased from the Fund upon the clearance of title and the approval of the financial arrangements involved in this transaction by both the Attorney General's Public Charities Division, as well as the Suffolk County Probate Court.

2.0 Financial Information

Robert Fox and his various related development entities run under the umbrella of Fox Properties, Inc., has heretofore financed the acquisition of the three parcels through Coolidge Bank and Trust Company and Capitol Bank and Trust Company. Fox Properties, Inc. has dealt extensively with Chase Manhattan Bank of New York, South Shore Bank of Quincy, Massachusetts, Old Stone Bank of Providence, Rhode Island, and Merchants Bank.

As indicated previously, the middle of the three parcels necessary for the advancement of the project is not presently owned by the developer. However, pursuant to the terms of the Agreement between the developer and the George Robert White Fund, said property is being purchased for a total purchase price of 1.5 million dollars, with one million dollars to be paid at the time of the delivery of good and marketable title, and the remaining $500,000.00 to be paid six months thereafter.

In this regard, arrangements have already been made with Coolidge Bank and Trust Company and a loan closing has occurred wherein the one million dollars has been set aside awaiting the delivery of a deed from the George Robert White Fund.

The requested development pro forma, operating pro forma, and sales pro forma will be sent to the BRA under separate cover.

3.0 Project Area

Attached hereto are the metes and bounds description of the two parcels already titled in the development entity. The first of these two parcels has an address of 144 Boylston Street, and was formerly occupied by the Mansfield Beauty Academy. The other existing structure, 150 Boylston Street, previously Devon On The Common, also fronts on Boylston Street, as does the third parcel under Agreement with the George Robert White Fund.

The access to the rear of the three parcels is through the private way off Boylston Street and shown on the Site Survey in Figure 1-2, made part of this submission as Carver Street. The rear access to the building is by way of a shared drive formerly known as Townsend Place at the rear of the State Transportation Building.

3.1 Parcel Boundary Descriptions

1) 150-152 Boylston Street Parcel

A certain parcel of land, together with the buildings and improvements thereon and appurtenances thereto, known as and numbered 150-152 Boylston Street, Boston, Suffolk County, Massachusetts, being bound and described as follows:

NORTHERLY by Boylston Street, 25 feet;

EASTERLY by land now or late of Robert T. Clark, Trustee, by a line through a party wall, 146 feet, 1 and 1/2 inches;

SOUTHERLY by a passageway leading to Carver Street, 25 feet; and

WESTERLY by land now or late of Charles U. Cotting, et. al., Trustees, by a line through a party wall, 146 feet and 6 and 3/4 inches,

however otherwise the premises may be bounded or described and all or any of said measurements more or less.

2) Parcel 1 - Unregistered

The land in Boston, Suffolk County, Massachusetts, with the buildings thereon now known and numbered 144 Boylston Street, bounded and described as follows:

Beginning at the Northwesterly corner of the premises on said Street; thence running

SOUTHERLY	on land formerly of David Townsend deceased, One Hundred Ten (110 feet and One (1) inch; thence
WESTERLY	about Four (4) feet, Three (3) inches more or less; thence
SOUTHERLY	again on land formerly of said Townsend, Seventy-seven (77) feet, Seven (7) inches to a passageway Thirteen (13) feet wide leading Westerly from Boylston Place to land late of said Townsend; thence turning and running
EASTERLY	on said passageway, Nineteen (19) feet, Nine (9) inches to another passageway which is registered land and was conveyed to the grantor herein as Lot B; thence turning and running
NORTHERLY	on said Lot B, Fifty-one and 62/100 (51.62) feet and by Lot A on the plan described below, Fifty-seven and 83/100 (57.83) feet; thence
EASTERLY	on said Lot A, Seven and 16/100 (7.16) feet; thence turning and running Seventy-eight (78) feet, Six (6) inches through the center of a brick partition wall to Boylston Street; thence
WESTERLY	on said Street, Twenty-four (24) feet, Eleven and One half (11 - 1/2) inches to the point of beginning.

3) Parcel 2 – Registered

A certain parcel of land situated in Boston, County of Suffolk, Commonwealth of Massachusetts, being shown as Lot B on Land Court Plan #6123B, filed with Certificate of Title No. 45650 and bounded and described as follows:

SOUTHERLY	by land now or formerly of George P. Upham et al Trustees, four and 62/100 (4.62) feet.
WESTERLY	by land now or formerly of Francis P. Nash et al, Fifty-one and 62/100 (51.62) feet;
NORTHERLY	by Lot A as shown on plan hereinafter mentioned, four and 40/100 (4.40) feet; and
EASTERLY	by lands now or formerly of Ancient Landmark Lodge I.O.O.F. and of Henry L. Higginson et al Trustees, Fifty-one and 62/100 (51.62) feet.

4.0 Relocation Information

It is the belief of the applicant that all Federal and State Relocation Regulations have no relevance to this project. The basis for this belief is the fact that the property known as 150 Boylston Street, previously used as a commercial building in its entirety, has sustained serious fire damage resulting in this building being totally gutted and boarded up. Consequently, there are no tenants in the building and have not been tenants in the building for a substantial period of time prior to this submission.

With regard to the property located at 144 Boylston Street, this property also consists of a four story commercial building, which is presently vacant with the exception of housing the offices of LDD Corporation, an entity run by Richard Donnelly and John S. Dennehy, Jr., two of the Limited Partners in this development scheme. There are presently four floors of commercial space in the building, which are scheduled to be demolished and replaced with the proposed buildings, as indicated in this submission once the developer's project is permitted hereunder.

As a result of the conditions of the buildings set forth herein, the buildings are presently yielding no monthly rent, house no minority businesses, and neither building presently contains any housing units. The project, once completed, however, will contain about thirty-nine residential condominium units.

5.0 Employment Plan

The developer estimates that approximately 100 people will be required to complete the construction of the project as presented. It would be the intention of the developer and the General Contractor of the developer once said General Contractor is determined, to use its best efforts to comply with the Boston Jobs Policy Requirements in hiring 50% Boston residents, 25% minorities, and 10% of women for the construction job of the person-hours worked.

With regard to the placement of permanent jobs, again the developer, to the extent that the developer has control over the placement of these jobs, will comply with all of the policies set forth by the City of Boston. With regard to those permanent jobs over which the developer has less control, the developer is nevertheless prepared to make all prospective tenants in the project aware of the appropriate policies and standards, and to suggest adherence to these policies and standards, making them aware of the Boston For Boston Agreement, the Boston Resident Jobs Policy and the Neighborhood Jobs Trust, and the guidelines made pursuant to each of these public programs.

6.0 Public Benefits

Based on extensive discussions with the BRA and the review of the guidelines established by practice insofar as other projects of similar scope, nature and design are concerned, the developer anticipates a housing payment to be yielded as a result of the construction of this project, which payment is expected to be $300,000.00. It is further expected that due to the nature of the project and the upgrading of the area, thirty-nine upscale, residential condominiums will be added to the tax base of the City of Boston, together with the commercial space as set forth herein.

The developer has also begun a process involving other property owners along Boylston Street that would lead to the upgrading of the sidewalk along the front of Boylston Street in an effort to improve not only the specific site being developed herein, but also the neighborhood as a whole.

7.0 Regulatory Controls and Permits

The project is presently located in a zone which permits the erection of the building as planned. However, variances will be required from the Rear Yard Requirments, from the Parapet Setback Requirements, from the Side Yard Requirements and from the Open Space Requirements. Also, a variance will be needed from the height requirements established under the Boston Zoning Code, Article 16. Further, a variance for floor area ratio (FAR) or permit for Enhanced Floor Area under the Downtown IPOD will be sought. Additionally, the applicant will need a variance for the elimination of the loading dock requirement, as well as a variance from certain aspects of the Architectural Barriers Requirement.

Approval also will be needed from the City of Boston Parks and Recreation Commission to have construction activities within 100 feet of the Boston Common.

With regard to the identification of Federal or State agencies from which permits or other actions will be sought, the applicant will need a Sewer Connection Permit from DEQE, Division of Water Pollution Control and a Construction Easement from the Executive Office of Transportation and Construction of the Commonwealth of Massachusetts.

The applicant may be filing an Environmental Notification Form (ENF), if necessary, under the Massachusetts Environmental Protection Act because of a potential plan change to the Urban Renewal Plan. The ENF would be filed with the Executive Office of Environmental Affairs. Also, a review under Massachusetts General Laws, Chapter 9, Sections 26(c) and 27(C) will be sought through the Massachusetts Historical Commission. The City of Boston Landmarks Commission has indicated that none of the properties necessary to assemble the total project are properties to be preserved as landmarks under the definitions used by that agency.

8.0 Community Groups

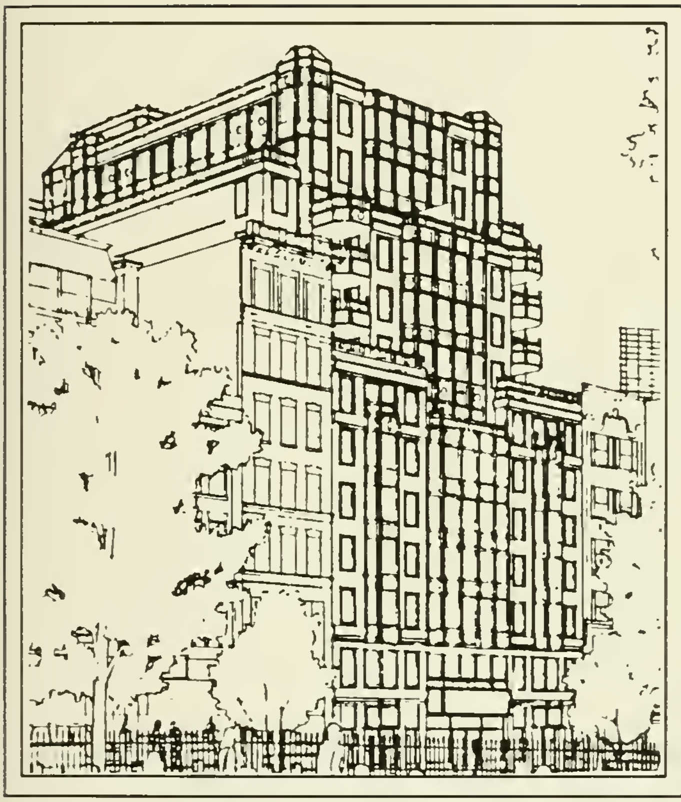
The applicant, with the assistance of the BRA, has previously met with an assemblage of representatives of the key community groups having input and concern over the project and the neighborhood in general in which the project will be located. This included representatives of the Park Plaza Civic Advisory Committee and local abutters. Based on the comments and suggestions of the representatives of the various neighborhood groups, the developer is prepared to cooperate completely with the appropriate groups.

The representatives of the Midtown Cultural District Task Force and the Park Plaza Civic Advisory Committee will be apprised of all development decisions and allowed to participate in same insofar as these decisions relate to any impact on the neighborhood in general and the quality of life therein.

Based on the channels of dialogue already opened up, it would be the intent of the developer to continue this process in an ongoing effort to develop this project in a cooperative manner with neighborhood representatives.

9.0 Affirmative Housing Plan

The 144-150 Boylston Street project has opted for provision of affordable housing opportunities off-site through a payment option. As previously referred to in Section 6.0 hereof, the developer, recognizes the need to provide public benefit to the City as this relates to affordable housing; and therefore, proposes to tender a housing payment for alternate housing off-site to provide necessary shelter for community residents as determined by the BRA and the City's Neighborhood Housing Trust. The amount proposed by the developer for this housing payment is $300,000.00 to be reviewed by the BRA and the City's Neighborhood Housing Trust.



IV. TRANSPORTATION COMPONENT

IV. TRANSPORTATION COMPONENT

1.0 Introduction

The proposed 144-150 Boylston Street project is located in an area of Boston considered to be sensitive to traffic circulation. Issues identified in the initial project scoping included questions regarding parking, loading for delivery vehicles, and traffic mitigation. In order to respond to these and other traffic related issues, the transportation assessment was conducted in three phases.

The first phase involved an inventory of existing traffic, parking conditions, and travel demand characteristics in the study area. The inventory included researching previous transportation studies as well as field data collection in order to obtain roadway geometrics and traffic data. Traffic counts were conducted for the PM peak hour at one of the two analysis locations (Charles Street/Boylston Street) and recent traffic counts were obtained for the other analysis location (Tremont Street/Boylston Street). In addition, a summary was made of the available public transportation system within the area.

The second phase of the transportation assessment included projection of the transportation impacts of the proposed project. Travel demand forecasts were calculated for the proposed project, including daily and peak hour trips by mode of travel. In addition, growth in vehicle traffic for other area projects approved or under construction was estimated. An analysis year of 1990 was established based on the projected completion date of the project.

The final phase of the transportation assessment, included an evaluation of the impacts of the project on the transportation and pedestrian system and identification of measures to mitigate any adverse impacts. Included within this effort was the development of an Access Plan for the 144-150 Boylston Street development.

2.0 Parking

The proposed project will provide 69 parking spaces - each space of about 8.5 feet by 20 feet. The plan includes 48 spaces to be located in the first and second level basements, and another 21 spaces to be located on floors 3 through 5 at the rear of the building. The entrance to the garage is to be located at the rear of the site along Carver Street, which is just west of the building site (see Figure I-5). Due to structural constraints, no ramp is planned for connecting each parking level. The plans call for an electric powered car lift or automobile elevator. This car lift can transfer a vehicle between each level, and will be the only method available for residents to access their vehicles.

Transfer of vehicles from individual spaces will be provided by an on-site parking attendant, who will move a requested vehicle to a temporary space located at the upper basement level, for personal access. Residents will be encouraged to schedule ahead for access to their vehicles at prearranged times. On-demand access to an individual's personal vehicle, assuming no other requests, is estimated to take on the order of five to ten minutes to obtain and move the car via the car lift. Since the attendant will also be responsible for returning vehicles to each resident's pre-arranged space, average demands placed upon the attendant service will likely find that the total time to access or park a vehicle may require about fifteen to twenty minutes. The car lift itself operates similarly to a personal elevator.

Although the site is located within the City of Boston "Restricted Parking District," parking at the project will be categorically exempt from the Downtown Parking Freeze requirements,* since the project includes only employee, residential, and non-commercial visitor spaces. Since commercial spaces are not provided, the requirements of the special zoning district do not apply.

Table IV-1 summarizes the estimated daily parking demand associated with the project. Residential parking demand resulting from the 144-150 Boylston Street project is estimated to have characteristics like those of other nearby developments of similar use. According to the recent Tremont-on-the-Common Resident Survey,** the automobile ownership ratio was found to be 0.7 automobiles per condominium unit for the residential

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* "Downtown Boston Parking Programs," Boston Redevelopment Authority (BRA), July 1981.

** Transportation Study and Access Plan for Parkside West, HMM Associates, Inc., 1987.

TABLE IV-1

DAILY PARKING DEMAND AND SUPPLY

Use	Estimated Demand	Supply
Residential	29*	53
Retail Employee	9	9
Residential Visitor	7	7
TOTAL	45	69

complex. Since the 144-150 Boylston Street project is similar to the existing Tremont-on-the-Common and is also located in the same area, this automobile ownership factor is appropriate to estimate the residential parking demand of the project. The plans for the project call for building between 37 and 41 residential units. For this study, 41 units have been conservatively assumed in order to calculate the associated parking demand. Based on 41 condominium units, 29 parking spaces represent the projected residential parking demand.

Parking demand has also been estimated for residential visitor use. Table IV-1 shows the estimate of parking demand for residential visitors allowed access to the project garage as space is made available. Seven long-term spaces represent the visitor long-term parking demand.

Retail parking demand was estimated based on empirical data from other developments in the area. In the 1987 Prudential Transportation Survey** it was determined that one parking space is allocated per two thousand leasable square feet (2000 square ft) for retail employee use. Based on the proposed 18,000 square feet of retail space, nine parking spaces are estimated to represent the retail employee long-term parking demand.

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* Based on the recent Tremont-on-the-Common Resident Survey conservative automobile ownership ratio.

** Prudential Survey, Cambridge Systematics, 1987.

The estimated residential and retail parking demands were then compared to the allocation of parking supply. These results are also summarized in Table IV-1. As indicated, the anticipated residential daily parking demand is for 29 spaces, while, the supply of allocated residential parking is assumed to be 53 spaces. Parking supply for the residential use provides an allocation of approximately 1.3 spaces per unit, guaranteeing each resident a minimum of one space per unit, and a total of 12 "second spaces" available to residents at market value. The actual supply of parking spaces for residents of the project will, however, be limited to the availability of 53 spaces. The parking supply allocation for retail employees (9 spaces) and residential visitors (7 spaces) is based on meeting the projected long-term parking demand for those particular uses.

3.0 Loading

Since the project is designed mainly for residential use, with only 18,000 square feet of retail space, it is not expected to have any significant site generated truck traffic. It was determined that retail businesses in the Back Bay area have a truck traffic generation rate of 0.24 truck trips (two-way) per 1,000 square feet of leasable space.*

The truck traffic generated by retail activities in the development will be minimal. A total of six (6) truck trips (in/out) per day are expected, which is only three trucks a day delivering to the site. Therefore, it has been determined that a truck loading dock is not required and will not be provided due to space limitations. The developer intends to file for a zoning variance from the City's loading dock requirements. Delivery of packages by single-unit trucks will be possible in the rear of the building at the entry/exit to the parking garage. The on-site parking attendant will monitor and coordinate delivery activities.

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* Copley Place EIR, HMM Associates, 1980.

4.0 Access

The proposed project traffic will utilize the existing alley known as Carver Street for all vehicle access/egress from the site garage at the rear of the building (see Figure I-5). No additional curb-cuts will be required. Furthermore, this driveway already operates under stop sign control for exiting vehicles. In the next section, an analysis of the operational conditions for vehicles entering/exiting Carver Street is provided based on the projected peak hour traffic condition with the project in place. Also, as indicated in the preceding section, truck loading can occur at the rear of the building for single-unit trucks. Adequate space is available for single-unit trucks to maneuver and turn around in this area near the project garage entrance/exit. Large semi trailer trucks would be required to negotiate and back into Carver Street, however, as is currently required. In addition, traffic circulation and maneuverability for personal automobiles within the private right-of-way on Carver Street, and at the rear of the project site, can be accommodated based on the site plan design.

Section 8.0 includes an Access Plan for the proposed development.

5.0 Vehicular Traffic

5.1 Street & Roadway Networks

The street system serving the proposed project consists of local streets, arterial roadways, and limited access highways. Important roadways serving the project area include:

- o Columbus Avenue and Tremont Street both provide arterial roadway access to/from points south and north of the proposed site;

- o Huntington Avenue which connects with Copley Square and Boylston Street also provides arterial access from points to the west.

The local street system west of the proposed project is a well defined, one-way grid system. In this area, major east-west streets include Commonwealth Avenue, Boylston Street, and Beacon Street. Other east-west streets include Newbury, Marlborough, and Stuart Streets, and St. James Avenue.

Major north-south streets west of the proposed project include Charles Street which provides major access between the Boston Common and Public Gardens from Park Square to Beacon Street, Arlington Street, Berkeley Street, Clarendon, Dartmouth Street, and Massachusetts Avenue.

In contrast to the grid street system to the west, the street system to the east, north, and south of the proposed project includes a more irregular system. Access to/from the proposed project from these directions is primarily oriented to the roadways as defined above including, Tremont Street, Columbus Avenue, and Huntington Avenue.

Figure IV-1 shows the directional flow of traffic on streets in the immediate study area. Boylston Street provides direct access to the proposed project, and currently provides two lanes for eastbound traffic flow toward Tremont Street, and one lane for westbound traffic flow toward Charles Street. Parking is not allowed on Boylston Street in this block along the Boston Common, however loading zone parking does occur for traffic flow eastbound along the curbside lane.

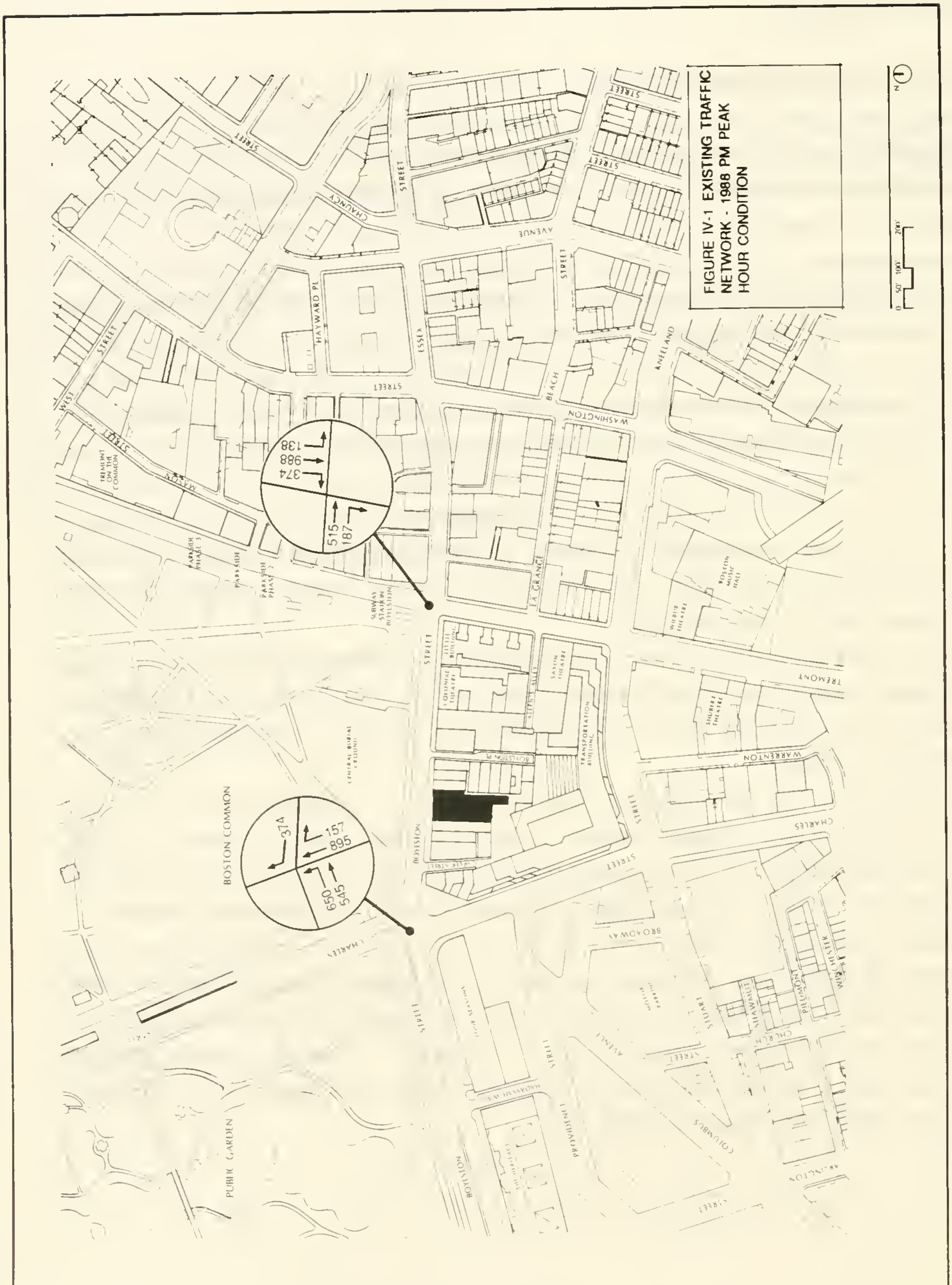

FIGURE IV-1 EXISTING TRAFFIC NETWORK - 1988 PM PEAK HOUR CONDITION

5.2 Traffic Operation Conditions Analysis

The analysis of traffic operations focused on a comparison of two intersections included in the study for conditions in 1988 (existing traffic network), in 1990 without the project (future base traffic network) and in 1990 with the project (future Build traffic network). The following paragraphs detail the determination of these networks and the results of the level of service (LOS) analysis.

Existing Traffic Network

The 1988 PM peak hour traffic volumes were developed based on manual turning movement counts at the intersections of Boylston Street with Charles Street and Boylston Street with Tremont Street. Since the traffic volumes were recorded in the month of June, the traffic volumes are considered representative of peak monthly traffic for the year. This determination is based upon traffic patterns analyzed from a nearby permanent traffic station located on I-93 near the Central Artery*. Volumes at this station for the months of June through September exhibited very similar daily volumes (within three percent), and volumes higher than any of the other months in the year. The existing traffic network for the 1988 PM peak hour condition is shown in Figure IV-1, representing the basis for analysis of the existing PM peak hour traffic operations condition.

Future Base Traffic Network

In order to establish the future base traffic network in the project completion year, adjustments were made to the 1988 existing traffic network to reflect the future traffic conditions in 1990 without the project. These adjustments included an annual growth rate based on overall traffic trends and a determination of background growth from other approved projects.

The annual traffic growth rate reflects the increases due to general growth in the region. For this particular project, MDPW count stations and other traffic studies in the study area were examined. The results showed that a two (2) percent annual growth rate can be applied to the existing traffic network to reflect future traffic conditions.

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* Massachusetts Department of Public Works, Traffic Volume 1986, Station 7900.

In addition to the proposed project, there are several other major developments under construction or in the planning stage. However, since the overall annual growth rate already reflects a significant amount of traffic generated by these developments, only the proposed Park Square Pavilion project generated traffic was added separately. The resultant 1990 base traffic network is shown in Figure IV-2 for the PM peak hour condition.

Project Trip Generation

To assess the impact of the proposed project on the transportation system in the site area, travel demand by type of use was estimated. The procedure used in estimating these trips consisted of calculating person trips per residential unit, and per 1000 square feet of retail space. Modal splits, vehicle occupancy factors, daily and peak hour trip rates, were determined for proposed residential and retail uses.

In order to determine the appropriate trip rates and trip factors for the project, research of empirical data available from other nearby area studies in the Back Bay/Boston Common area was conducted. Specific studies referenced in this determination included:

- Trip Generation Manual, 4th Edition, Institute of Transportation Engineers, 1988.
- Prudential Survey, Cambridge Systematics, 1987.
- 500 Boylston Street Project DEIR, Skidmore, Owings, Merrill, et al., October 1984.
- Copley Place EIR, HMM Associates, Inc., 1980.
- Diversity and Change, 1970-1980, BRA, 1986.
- Transportation Study and Access Plan for Parkside West, HMM Associates, Inc., 1987.

The development program analyzed for the proposed project included 41 residential units, a resident health club, and about 18,000 square feet of retail space. The health club is considered for resident use only and therefore is of no consequence to the calculation of trip rates. Tables IV-2 and IV-3 summarize the daily and peak hour trip generation factors, respectivey, used in the analysis and present the resultant person trips based on the proposed development plan. A total of 1,034 daily person trips, including 517 arrivals

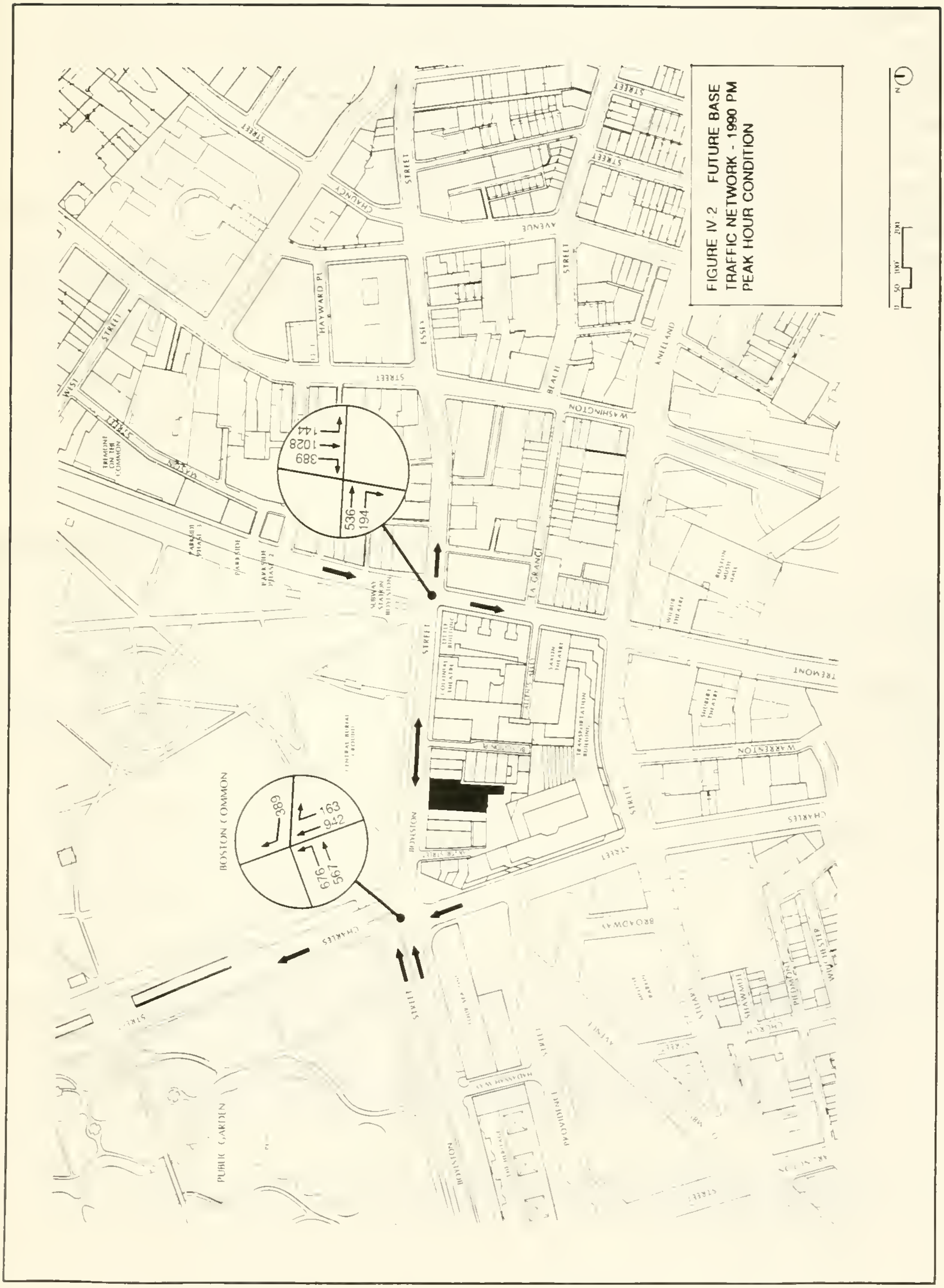

FIGURE IV 2 FUTURE BASE TRAFFIC NETWORK - 1990 PM PEAK HOUR CONDITION

and 517 departures, are estimated to be generated by the proposed project. As shown in Table IV-3, only 34 person trips are estimated to occur during the AM peak hour, and 93 person trips are estimated to occur during the PM peak hour.

Modal split factors were determined based on recent surveys and retail patron surveys conducted for both the nearby Parkside West development and Prudential Center developments. Table IV-4 shows the percentage and number of person trips by walk, transit and auto modes.

Table IV-5 summarizes the vehicle occupancy rates assumed for those project trips arriving by auto. These rates are consistent with other nearby projects in the Back Bay.

TABLE IV-2

DAILY PERSON TRIP GENERATION

	Trip Rate				Person Trips		
Use	In	Out	Total	Source:	In	Out	Total
Residential (41 units)	4.5	4.5	9.0	(1)	185	185	370
Retail (18,000 sq. ft.)							
- Employee	2.7	2.7	5.4	(2)	49	49	98
- Other	15.6	15.6	31.2	(2)	283	283	566
TOTAL DAILY PERSON TRIPS					517	517	1,034

Source: (1) Trip Generation Manual, 4th Edition, Institute of Transportation Engineers, 1988. ITE vehicle trips converted to person trips assuming an average of 1.4 persons per car and a 10% allowance for non-auto travel. These rates produce a slightly higher person trip generation for peak hour periods than surveys have indicated at the Prudential Center and Tremont on the Common, however, are considered acceptable for this study. Rate is per unit.

(2) 500 Boylston Street Project DEIR, Skidmore, Owings, Merrill, et al., October 1984; Copley Place EIR, HMM Associates, Inc., 1980. Rate is per 1,000 sf of space.

TABLE IV-3

PEAK HOUR PERSON TRIP GENERATION

Use	Peak Hour Rate or % Peak Hour Contribution In	Out	Source:	Peak Hour Person Trips In	Out	Total
AM PEAK HOUR						
Residential*	.11	.57	(1)	5	24	29
Retail**						
- Employee	10%	0%	(2)	5	0	5
- Others	0%	0%	(2)	0	0	0
TOTAL AM PEAK HOUR				10	24	34
PM PEAK HOUR						
Residential*	.58	.29	(1)	24	12	36
Retail**						
- Employee	10%	20%	(2)	5	10	15
- Others	5%	10%	(2)	14	28	42
TOTAL PM PEAK HOUR				43	50	93

* Peak hour person trips per unit.

** Percent of daily trips during peak hour.

Source: (1) Trip Generation Manual, 4th Edition, Institute of Transportation Engineers, 1988.

(2) 500 Boylston Street Project DEIR, Skidmore, Owings, Merrill, et al., October 1984; Copley Place EIR, HMM Associates, Inc., 1980.

TABLE IV-4

PERSON TRIPS BY MODE

Use (Users)	Walk	Transit	Auto	Source
Percentages:				
Residential (all)	45%	30%	25%	(1,2)
Retail (Employees)	58%	16%	26%	(3)
Retail (Other)	23%	55%	22%	(3)
Daily Person Trips*:				
Residential (all)	166	112	92	
Retail (Employees)	16	56	26	
Retail (Other)	312	130	124	
Total (1034):	494	298	242	

* Includes all arrivals and departures.

Source: (1) Diversity and Change, 1970–1980, BRA, 1986.
(2) Transportation Study and Access Plan for Parkside West, HMM Associates, Inc., 1987.
(3) Prudential Survey, Cambridge Systematics, 1987.

TABLE IV-5

VEHICLE OCCUPANCY RATES

Trip Category	Average Persons per Vehicle*
Residential (All)	1.5
Retail (Employees)	1.4
Retail (Other)	1.6

* Source: Copley Place EIR, HMM Associates, Inc., 1980; 500 Boylston Street Project DEIR, Skidmore, Owings, Merrill, et al., October, 1984.

Applying the vehicle occupancy rates to the person-trips by auto mode results in a total estimate of 158 daily vehicle trips as shown in Table IV-6. These were distributed equally to inbound and outbound trips.

TABLE IV-6

DAILY VEHICLE TRIPS

Trip Category	Number of Trips: Arrivals (In)	Number of Trips: Departures (Out)	Auto
Residential (All)	31	31	62
Retail (Employees)	9	9	18
Retail (Other)	39	39	78
TOTAL	79	79	158

The number of trips occurring during the peak commuter hours are of greater concern than the total daily trips. It is these peak periods which represent the highest level of traffic congestion and are used to evaluate the performance of the transportation system. The peak hour factors were applied to the daily vehicle trips to obtain the number of vehicle trips generated by the project during the peak traffic hour, shown in Table IV-7.

A total of 6 vehicle trips are projected for the morning peak hour, including 2 arrivals and 4 departures, while 15 vehicle trips are projected for the evening peak hour, including 7 arrivals and 8 departures.

TABLE IV-7

PROJECT PEAK HOUR VEHICLE TRIPS

	AM		PM	
Trip Category	Arrivals	Departures	Arrivals	Departures
Residential (All)	1	4	4	2
Retail (Employees)	1	0	1	2
Retail (Other)	0	0	2	4
TOTAL	2	4	7	8

Future Build Network

The future build traffic network was developed by adding the project generated traffic to the future base traffic network. Trips were distributed and assigned to the street system based on the directional splits of traffic in the existing traffic network. The resultant traffic network for the PM peak hour Build condition is shown in Figure IV-3.

Traffic Flow and Operating Characteristics

Signalized Intersection Analysis

Traffic flow and operating characteristics are measured in terms of level of service (LOS) and average delay per vehicle. Two intersections, Boylston Street with Charles Street, and Boylston Street with Tremont Street, were analyzed. Both intersections are signalized and were analyzed by using the signalized intersection capacity analysis procedures. This method is described in the Highway Capacity Manual Special Report 209, published by the Transportation Research Board, Washington, D.C., June 1985.

LOS is a term which denotes the different operating conditions which occur on a given roadway or intersection when accommodating various traffic volumes. It is a qualitative measure of the effect of a number of operational factors including roadway geometrics, speed, travel delay, freedom to maneuver and safety. This method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on delay. LOS designations are based on the criterion of calculated average stopped delay per vehicle. Table IV-8 summarizes the relationship between LOS and delay. The tabulated delay criterion may be applied in assigning level of service to approaches, or to entire intersections.

Level of service can range from LOS A to LOS F. LOS A describes operations with very little delay (i.e., less than 5.0 seconds per vehicle). This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. LOS F describes operations with delay in excess of 60.0 seconds per vehicle. This condition, characterized by congested conditions, is considered to be unacceptable to most drivers. Between LOS A and LOS F, traffic conditions and delays become progressively worse. Level of Service D or better is generally considered acceptable in urban areas.

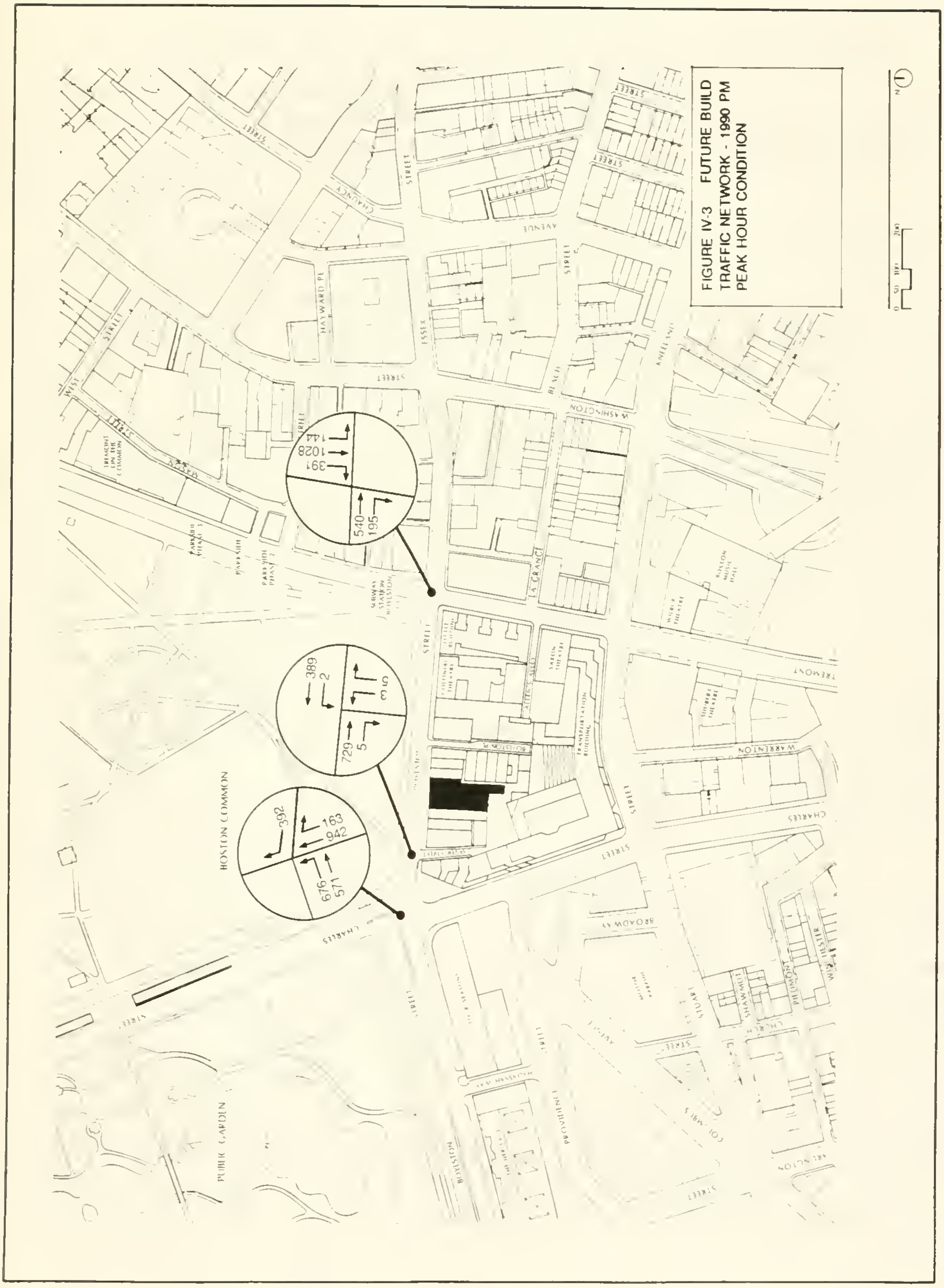

FIGURE IV-3 FUTURE BUILD TRAFFIC NETWORK - 1990 PM PEAK HOUR CONDITION

TABLE IV–8

LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

Level of Service	Stopped Delay per Vehicle (sec.)
A	< 5.0
B	5.1 to 15.0
C	15.1 to 25.0
D	25.1 to 40.0
E	40.1 to 60.0
F	60.0

Source: Transportation Research Board, Special Report 209, Highway Capacity Manual, Washington, D.C., 1985.

TABLE IV–9
SUMMARY OF LEVEL OF SERVICE ANALYSIS
PM PEAK HOUR

	1988 Existing		1990 Base		1990 Build	
Intersection	Delay (Seconds)	LOS	Delay (Seconds)	LOS	(Seconds)	LOS
Boylston St./Charles St.	21.1	C	21.8	C	22.1	C
Boylston St./Tremont St.	21.3	C	22.6	C	22.8	C

Table IV–9 summarizes the existing and projected LOS for the PM peak hour traffic conditions for both signalized intersections on Boylston Street. Both intersections will experience a minimal increase in average intersection delays. The intersection of Boylston Street with Charles Street which currently operates with an average delay of 21.1 seconds and with a delay of 21.8 seconds in the future base condition, will operate at a minimally higher average delay of 22.1 seconds with the project. Similarly, the intersection of Boylston Street with Tremont Street operates with an average of 21.3 second delays, compared with an average of 22.6 second delays in the future base traffic network condition. With the project, delays will only increase to 22.8 seconds. Both intersections will operate at LOS C under all three conditions.

Unsignalized Intersection Analysis

The site-generated traffic will utilize Carver Street to the west of the site for exiting and entering vehicles from the parking garage. In order to determine the impact of the site access on the through traffic on Boylston Street, an unsignalized intersection analysis was performed.

LOS for unsignalized intersections is determined by using a gap frequency/ acceptance analysis procedure. This methodology can be applied to unsignalized intersections that are controlled either by STOP or YIELD signs. In capacity calculations for an unsignalized intersection, the assumption is made that the major street traffic is not affected by the minor street movement.* The capacity of the intersection is a function of: the right turns into the major road, the left turns from the major road, through traffic crossing the major road and left turns into the major road; and the number of acceptable gaps in the through traffic streams which allow turning or crossing vehicles to pass through the intersection. An acceptable gap of six seconds was used for vehicles exiting Carver Street. Based on a gap acceptance function,** the theoretical capacity of the minor approach can be determined. The capacity can then be compared to the demand volumes and a level of service assigned based on reserve capacity. Table IV-10 presents the level of service for an unsignalized intersection compared to delay characteristics and reserve capacity. The difference between available capacity and existing demand is defined as reserved capacity and is used as the criteria for determining level of service.

Table IV-11 summarizes the LOS for the site access driveway at Carver Street with Boylston Street for PM peak hour traffic volumes under the Build condition. As shown, site access will operate at LOS B which reflects minimal delays.

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* TRB Circular 212, Interim Materials on Highway Capacity.

** TRB, Special Report 165, Traffic Flow Theory.

TABLE IV-10

LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS

LOS	Reserve Capacity*	Expected Traffic Delay
A	400 or more	Little or no delay
B	300 to 399	Short traffic delay
C	200 to 299	Average traffic delay
D	100 to 199	Long traffic delay
E	0 to 100	Very long traffic delay
F	Less than 0	Failure (extreme congestion) or intersection blocked by external causes

* Passenger cars per hour.

TABLE IV-11

LEVEL OF SERVICE ANALYSIS AT SITE ACCESS

1990 BUILD CONDITION

		PM Peak Hour		
Location	Movement	Demand	Reserve Capacity	LOS
Site Access at Carver Street and Boylston Street	Boylston Street WB*	389	462	A
	Site Access NB	8	337	B

* Critical Movement Analyzed

6.0 Public Transportation

6.1 Available Public Transportation

The proposed development provides easy access to many downtown and metro-area activities with little need for auto travel. Access to workplaces, downtown activities, and the regional transit system are excellent from the project site. Figure IV-4 illustrates the MBTA services available to the project site. As shown in Figure IV-4, three major transit lines are within short walking distance from the proposed project.

The Green Line provides service from the Park, Boylston and Arlington stations to Cambridge (Lechmere) and points west via four branches: Riverside, Boston College, Cleveland Circle, and Heath/Arborway. The Orange Line provides service from the Washington and Essex stations to Forest Hill and Oak Grove. The Red Line provides service from the Park and Washington stations to Cambridge (Alewife) and south to Mattapan and Braintree. Additionally, passengers can transfer directly from the Green and Orange Lines to the Blue Line, and from the Green, Orange and Red Lines to commuter rail.

6.2 Measures to Encourage Use of Public Transportation

The provision of in-town residential condominiums is, in itself, a measure which reduces vehicle trips. Because this type of development brings residents within easy walking distance to their places of employment or local rapid transit services, the mode split for walk and transit trips is inherently high. In most cases, the work trip commute is faster and less expensive by foot or transit than by auto. However, in addition to the inherent encouragement of transit use by in-town residential condominiums, the distribution of transit information (maps and schedules) in the lobby of the condominium will further encourage transit use. This effort, when paired with a resident-sponsored MBTA pass program, can be particularly effective in encouraging transit use.

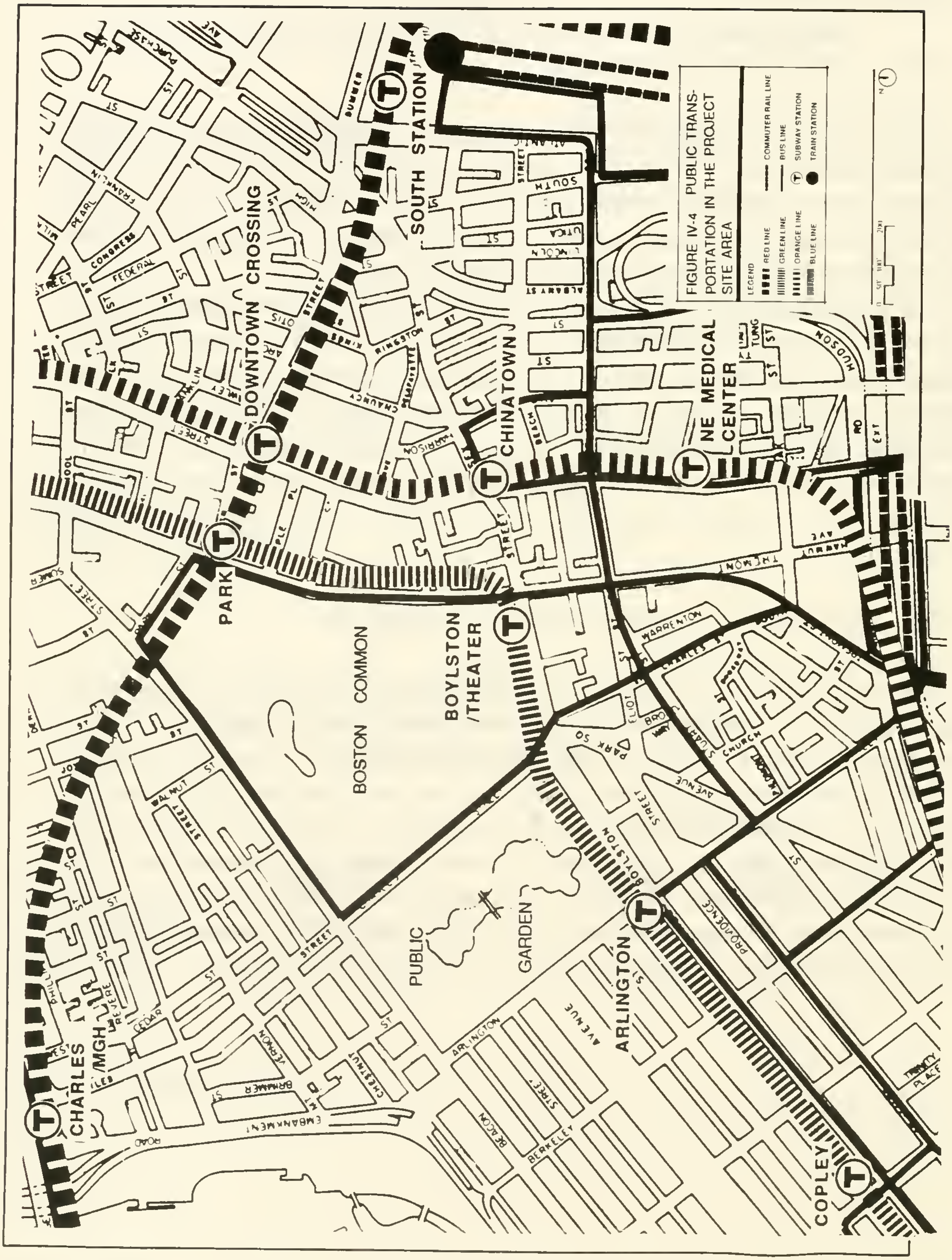


FIGURE IV-4 PUBLIC TRANSPORTATION IN THE PROJECT SITE AREA

7.0 Pedestrian Circulation

As summarized in the previous section, the proposed project will generate an estimated 792 person walk trips daily, 26 of which will be made in the AM peak hour and 71 in the PM peak hour. These person walk trips include both transit users and walk only trips to and from the residential units and retail stores. Based on these numbers, no significant impact to the existing pedestrian circulation system is expected due to the relatively small amount of new pedestrian trips generated.

Pedestrian circulation safety was also examined including the physical condition of the sidewalk. The existing sidewalk at the entrance to the proposed project along Boylston Street is well defined for pedestrian use. Sidewalk width is 12 feet wide throughout the blockface. In addition, at both signalized intersections of Boylston Street with Charles Street and Boylston Street with Tremont Street, pedestrian crossing pavement markings are well defined to delineate the pedestrians crossing at the intersection. Traffic signals at both intersections are equipped with pedestrian push-button actuated pedestrian crossing phases. These exclusive pedestrian crossing phases provide for safety and allow pedestrians some priority in traffic flow operations.

The proposed project garage exit will be utilizing the existing alley way, Carver Street, as the main access. The alley is "Stop" sign controlled and project vehicles exiting from Carver Street will be required to obey this traffic control as a pedestrian safety measure. Utilizing this existing alley for site-generated traffic is not expected to exert significant impact to the pedestrian activities on the sidewalk along Boylston Street, since the number of vehicles, particularly during the peak traffic condition, are not significant. Furthermore, the Carver Street access is already currently utilized for delivery vehicles without significant impact on pedestrians.

8.0 Access Plan

The 144–150 Boylston Street project will not significantly impact the transportation system in the area. The project is an in-town residential building with a modest amount of retail space on the first two floors. Location and building design both suggest a site use which will fit into the area transit and walk mode orientations. Parking to be provided will be controlled for resident, retail employee, and limited visitor use through provision of an on-site twenty-four hour parking attendant. Proximity to area jobs, businesses, and social activities will limit the need for vehicle trip-making, and be within close proximity to an adequate transit and pedestrian transportation system. As documented in this report, minimal peak hour vehicle trips are projected due to the scale of the development plans.

Project proponents intend, however, to undertake measures as part of this Access Plan to direct and manage site activities and traffic demand, in order to further enhance the project's fit into the area. These mitigating measures for the project are in the areas of encouraging non-ownership of personal automobiles, encouraging transit use, fostering ride share opportunities, managing the parking supply, and overall parking garage operations.

The following elements of the project Access Plan set forth the commitment to these mitigating measures by the project proponent.

8.1 Parking Management Element

The project's parking supply will be managed to encourage reduced daily and peak hour trips. Measures which would accomplish this include:

- o Establishment of a parking management function within the physical management staff, with a parking attendant staff person to monitor, assist, and control the use of on-site parking, with the primary objective to reduce peak hour use of resident and tenant vehicles.

- o Although parking will be provided at a minimum of one space for each residence, attempts will be made to keep car ownership much lower. A convenient system of car rental will be administered and promoted by building management. Rental cars will be reserved and made available

through the management office at the building. Knowing that this convenient service is available should dissuade many residents from owning cars, and further reduce potential peak hour trips.

- o Allocation of parking spaces on the upper basement (entry) level should seek to accommodate in priority order retail employees, visitors, and ride-sharing tenants. Each of these groups will minimize overall peak hour vehicle traffic impacts. In other words, spaces should be most accessible to the users not projected to enter or leave the building during the peak hour (employees and visitors), and encourage those residents who must drive to work to share the ride wherever practical to do so.

- o A convenient parking space for a van or high occupancy vehicle will be provided on the upper basement (entry) level. The building management, through ownership assessments or association fees, will encourage the purchase of a single van for tenants' use. Although the van will be primarily available for special event needs by the tenants, the use of the vehicle for daily shuttle service is another recommendation, seeking to further lessen the desire for tenants to use personal automobiles during peak hours, particularly at times of inclement weather.

- o A fee structure should be a policy of the parking management plan, assessed on an upward scale basis to tenants for requiring access to personal automobiles per frequency of access and daily use during the AM or PM commuter peak hours. The auto elevator itself provides a hassle factor which will minimize the use of personal automobiles to a large extent, since parking management staff will be required to move the vehicles to the lower garage level for tenant use. Enactment of a fee structure based on the frequency and time of access will encourage off-peak usage and possibly generate association revenues to support the parking management plan.

8.2 Public Transportation Element

The location of the project is ideally situated to result in a large percentage of transit usage by residents, visitors, and building employees. Projections made in this study document a high percentage of non-auto daily trips which will include

transit trips (47%) and walk trips (29%). The building management's commitment to transit usage will further reduce the potential for daily and peak hour auto trips. The project proponent will enact the following two measures:

- o Distribute MBTA maps and schedules to tenants at the time of occupancy, and on an on-going basis in the lobby of the building;
- o Encourage retail tenants through leasing requirements to provide for an employee-sponsored MBTA pass program.

8.3 Trip Reduction Element

The parking management, public transportation, and construction management elements described in this Access Plan, all intend to discourage vehicle trips to the building and encourage use of public transportation, particularly during the daily peak hours of traffic. Additional commitments by the building proponent will further lessen any potential traffic impact. The following items outline these trip-reduction measures:

- o Provision of secure bicycle storage space located on the upper garage level for building residents and retail tenant use.
- o The project proponent will appoint a staff person in the building management office whose responsibilities will include the coordination of all of the Access Plan efforts. This Transportation Coordinator will be the City's key contact with the building management and will have the authority to resolve transportation issues as they arise.

8.4 Construction Management Element

An important component of the Access Plan is an effective series of measures designed to minimize traffic flow and safety impacts during the construction phase. Summarized below are several measures which are expected to be incorporated into the construction management plan for the project:

- o Secure fencing, staging and bracing will be provided at the curb around the entire site to protect pedestrian traffic near the construction site. Sidewalks along the site will be enclosed during the construction period for pedestrian safety and continued pedestrian flow.

- o The staging area for construction materials is to be located at the rear of the site with access provided along Carver Street.

- o Use of the adjacent curb lane may be required on Boylston Street for unloading of construction delivery trucks. Use of these lanes will occur only during off-peak traffic hours and procedures will be followed in order to assure traffic flow and safety.

- o Police control will be used as required to facilitate traffic flow and insure pedestrian safety.

- o Construction worker parking will be arranged at the Commons parking garage at a fee yet to be determined.

- o Worker shifts will be scheduled so as to minimize conflict with the AM (7-9) and PM (4-6) commuter peak hour traffic.

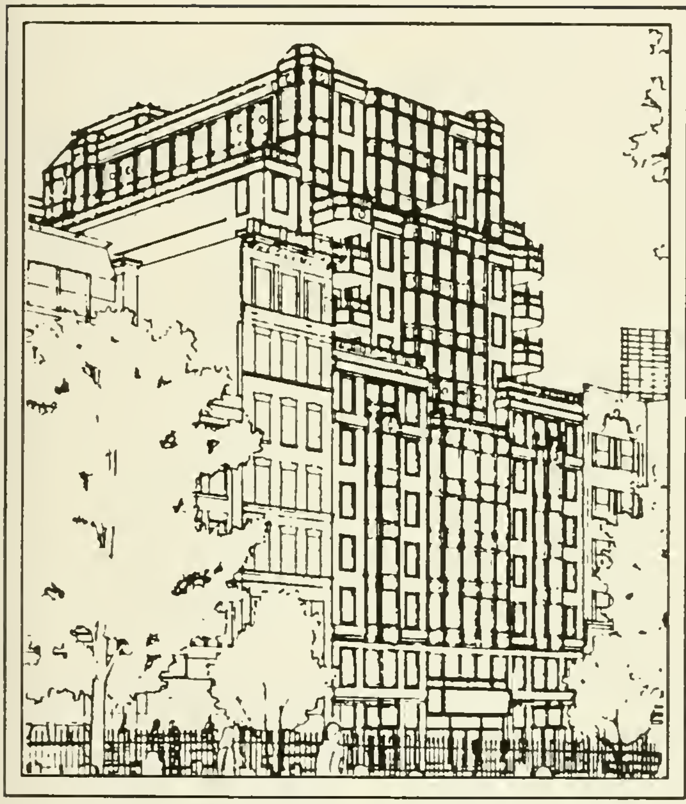
8.5 Monitoring and Reporting Element

In order to verify the building users' trip-making characteristics, the proponent is committed to the following on-going measures to be performed by the building management:

- o Record-keeping by the on-site parking attendant of all vehicles entering/exiting the parking garage, with monthly reports of daily trips in and out by resident, retail tenant and visitor breakdowns.

- o Monitoring and recording by building security of the number of visitors to the building on a daily and monthly basis.

- o Periodic surveys of the building tenants in order to determine trip-making frequency and mode of travel.



V. ENVIRONMENTAL PROTECTION COMPONENT

V. ENVIRONMENTAL PROTECTION COMPONENT

1.0 Wind

1.1 Introduction

The Development

The 144-150 Boylston Street project is an urban redevelopment effort in Boston on Boylston Street between Charles and Tremont Streets. The project building is approximately 125 feet tall situated between buildings of 60 to 85 feet in height along Boylston. Boston Common (Central Burial Ground portion) is located across the street to the north. On the south half of the project block is the State Transportation Building.

The projection of the 144-150 Boylston building above its neighbors, its increased height over pre-existing buildings on the site, and its prominent location across the street from Boston Common (where winds may be higher than in built-up city areas), indicate the need to assess its impact on pedestrian wind comfort.

The Wind Studies

Cermak Peterka Petersen, Inc. was retained to study the potential pedestrian level wind impacts, using wind-tunnel testing, associated with the development of 144-150 Boylston Street. The wind-tunnel study involved flow visualization testing to qualitatively assess wind impacts.

The study had several objectives:

- Provide general conclusions on the nature of the wind environment in the project site area.
- Describe, qualitatively, the nature and locations of project-related changes in the wind environment.
- Test the relative difference in wind environment associated with project development.

The objectives were accomplished through "smoke test" observations of flow patterns in the wind tunnel for a variety of wind directions.

1.2 Nature of Urban Winds

Urban Wind Characteristics

The winds blowing over a city are slowed and mixed by interaction with trees, buildings, and other features which contribute to "surface roughness." The result of this interaction is that the average wind speeds increase with elevation above the local terrain up to a level called the gradient height (usually 275 to 400 meters, or 900 to 1,350 feet). Above this level, the wind speed is known to be relatively constant and unaffected by the surface development. This region where the surface roughness affects the wind characteristics is known as the atmospheric boundary layer.

High winds at ground level around tall buildings result from the interaction between the buildings and the higher-speed winds that exist at greater heights. The pressure exerted on the windward face of a building increases with wind velocity. Thus the pressures will be greater near the top than near the bottom of the building. As a result of this vertical pressure gradient, high level winds are deflected down the building face from the high pressure to the lower pressure region. For an isolated building, winds flowing down the windward face hit the ground and are accelerated around the windward corners by low pressures existing on the sides of the building. High wind speeds at ground level are most pronounced near tall buildings which are surrounded by structures whose heights are low in comparison to the tall building. At ground level, the highest winds are often found around building corners. This corner flow is usually steady high-speed wind that changes to a lower speed but gusty wind as it moves farther from the building. The presence of other nearby buildings can also redirect winds and cause additional increases in wind speed due to funneling or channeling.

For the 144–150 Boylston building, the presence of abutting buildings on the east and west whose heights are a significant fraction of the 144–150 building height will prevent the formation of high corner winds. Winds deflected downward by the building will spread along the street as they approach pedestrian level. The major wind-related features of the structure are expected to be the filling of a previously open area in the block facade and increasing of the facade height near the street. Both of these features of the building could potentially increase wind speeds along the sidewalk on the south side of Boylston Street between Charles and Tremont Streets.

Boston Wind Climate

Winds which affect Boston are due to both coastal effects and to the generally west to east pattern of global circulation. A brief discussion of some of these effects are presented in Appendix B. A summary of winds affecting pedestrians is shown in Figure V-1. The probability of winds blowing with certain magnitude from various directions is shown in Figure V-1a while the likelihood of winds approaching from any one direction is shown in Figure V-1b. The data are from an anemometer 22 feet above ground at Logan International Airport.

Winds are stronger during the winter (December-February) and spring (March-May) than for summer (June-August) or fall (September-November). Westerly winds predominate, particularly during winter when 52 percent of the time the winds come from the quadrant WSW to NW and only 10 percent from the easterly quadrant ENE to SE. The strongest winds also originate from the west in winter.

During the summer, the directions for winds are somewhat more evenly divided with 34 percent from the WSW to NW quadrant and 24 percent from the ENE to SE quadrant. The division of strong winds between east and west is also more evenly divided during summer than in winter. On the whole, winds are generally weaker in summer than in winter.

Spring and fall are transitions between winter and summer and thus are a mixture of the two seasons. In fall, September and October are more like summer in character, but a little stronger in wind speeds. November is much like winter in its wind distribution, but with slightly less wind magnitude. In spring, March and April are much like winter in distribution of directions, but lower in speed, while May is more like summer in direction distribution and wind magnitude.

1.3 Flow Visualization Testing

Study Approach

Pedestrian level winds were studied in an atmospheric boundary-layer wind tunnel utilizing flow visualization techniques with a smoke tracer of TiO_2. The flow visualization methodology involved observing wind flow patterns at ground level in the study area with a smoke probe. A model of the proposed site and surroundings was developed at a scale of 1:350. The model covers the area within a radial distance of 1800 feet from the site. Wind engineering testing techniques are discussed in references 1 through 3.

Vertical wind speed profiles were developed to simulate actual wind conditions in the project area. A mean velocity distribution following a power-law variation with height of 0.24, was used. The wind tunnel provides the capability of rotating the model so that pedestrian level winds can be simulated and examined at different wind directions. By performing the wind analysis at a number of wind directions, "hot spots" of high velocities may be identified. An experienced practitioner can quickly cover a wide area, identifying hot spots and recording wind speed levels.

Examination of pedestrian winds should not concentrate only on high velocity "hot spots." Areas where low velocities are changed to moderate velocities for a number of wind directions may represent a deterioration in pedestrian environment. The reverse is also true. High pedestrian traffic areas should be addressed even if "hot spots" are not evident, as modest changes in environment may change pedestrian traffic patterns. This is particularly true for pedestrian areas which were designed for long-duration activities.

In addition to defining wind speeds at ground level, smoke visualization provides an understanding of why a particular flow speed exists by examining the flow conditions upwind and above the surface. For example, high wind velocities at the corner of a building may be seen to be the result of wind flow down the windward face of the building causing wind to "converge" toward the surface at the corner.

Using this technique, a qualitative evaluation of local wind speed was obtained by classifying wind speeds into categories of high, moderate, low, and stagnant. A moderate wind speed is best representative of the velocity in an open area away from any significant influence of structures. High wind speed is a velocity significantly faster than "moderate." High wind speeds are usually observed at isolated spots rather than in large areas. For this study, any high velocity "hot spot" in an area would result in classifying the entire area as high velocity. Low velocity is lower than moderate wind speed, but not stagnant. Stagnant indicates very little or no air motion in an area. Where an area was classified as high, maps were marked with the location of the high velocity "hot spots" within the area as well.

For the 144–150 Boylston project, smoke tests were made for 22 specific study areas identified on the site map shown in Figure V–2a. Each area was examined by smoke flow for each of the eight compass points. For each wind direction the velocity in each different area was rated in one of the four wind speed categories described above and high–velocity areas were recorded. The results are presented in Table V–1 and Figures V–3 and V–4.

A videotape of selected portions of the flow visualization test was made as a record of the qualitative study.

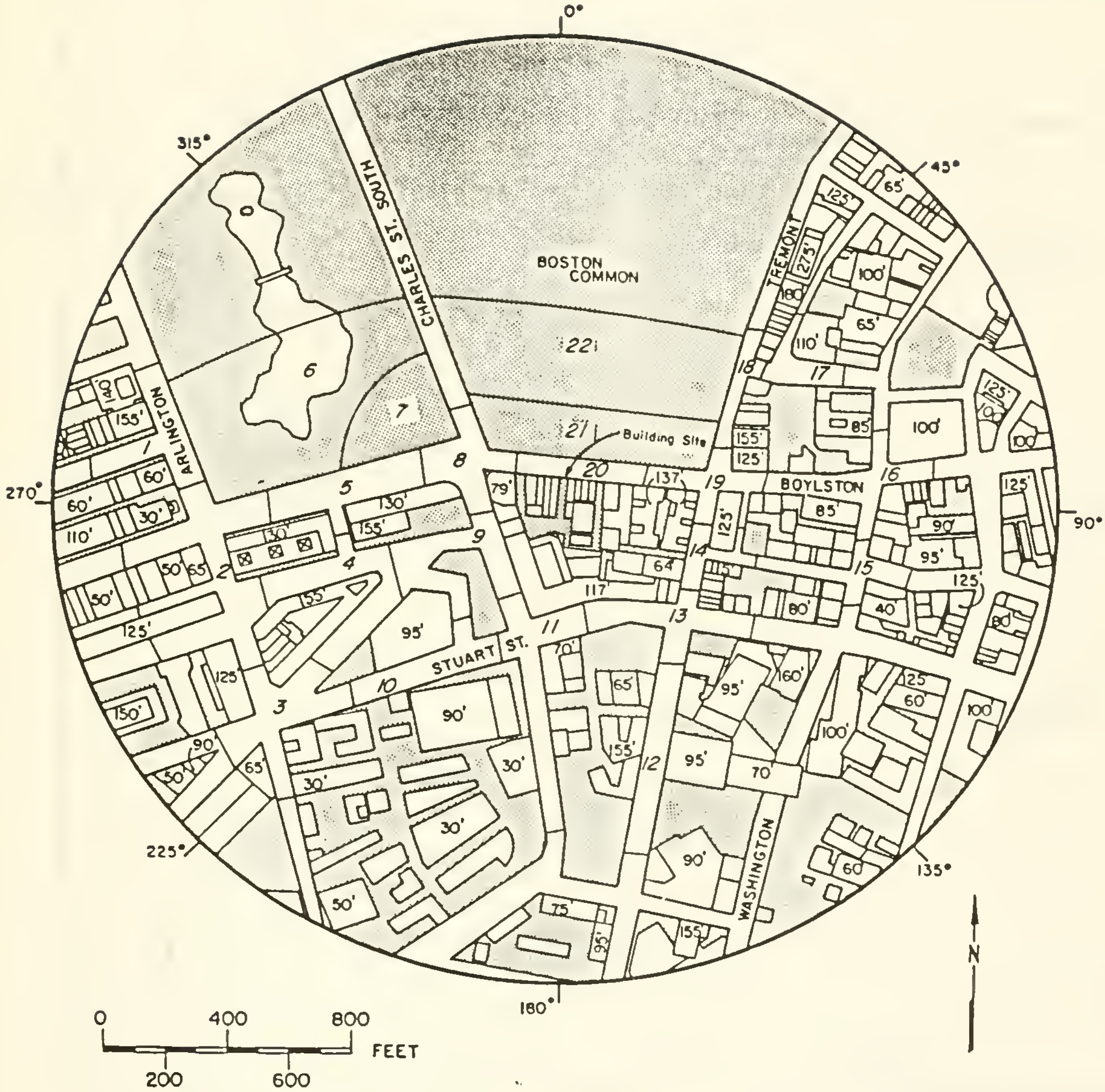


FIGURE V-2a SITE LOCATION AND SURROUNDINGS - EXISTING

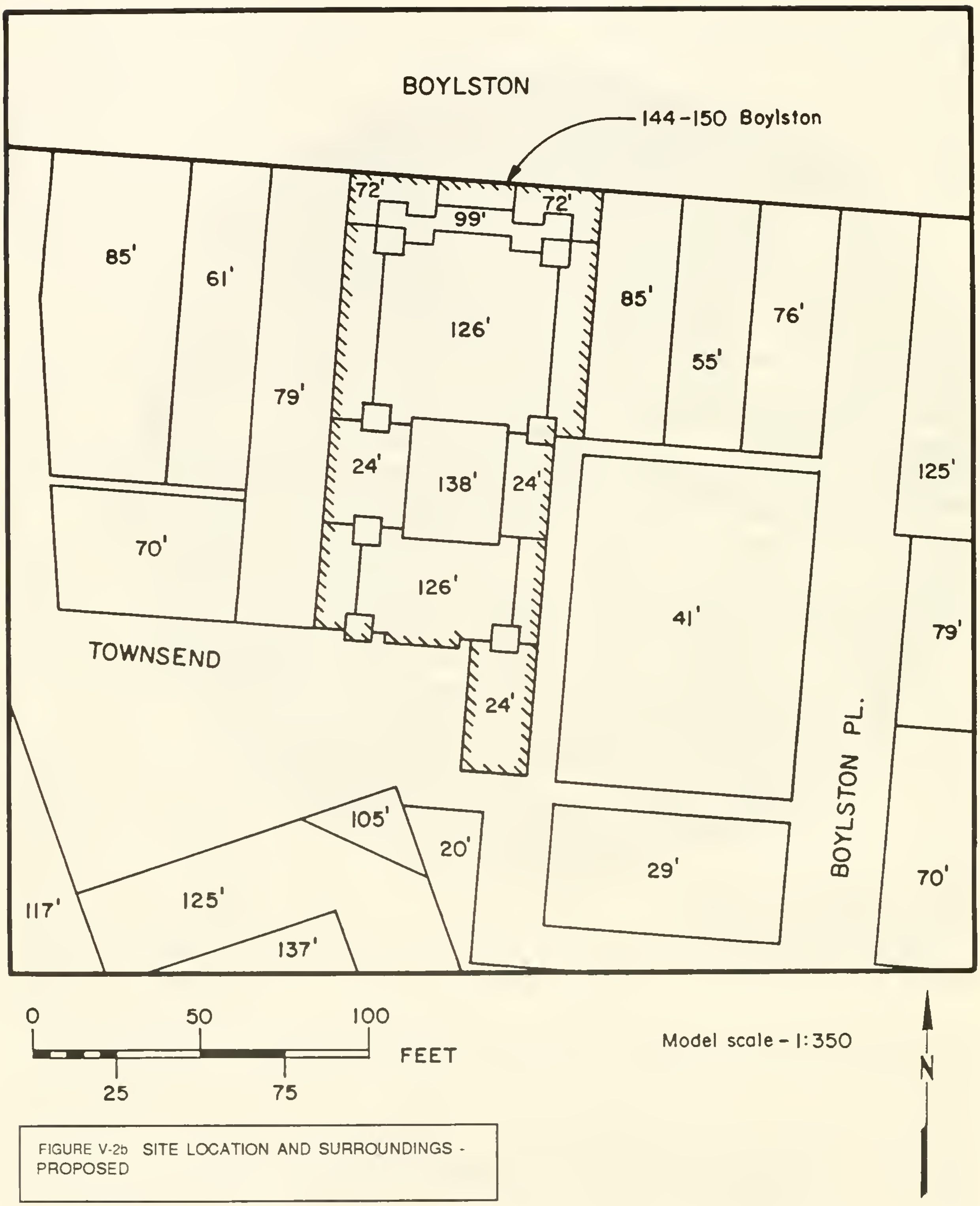


FIGURE V-2b SITE LOCATION AND SURROUNDINGS - PROPOSED

TABLE V–1

RESULTS OF FLOW VISUALIZATION STUDY

Number of Wind Directions with Specified Wind Speed

Zone #	Configuration	Wind Speed			
		High	Moderate	Low	Stagnant
1	A – No–Build		4	4	
	B – Build		4	4	
2	A	2	3	3	
	B	2	3	3	
3	A		5	3	
	B		5	3	
4	A	1	4	3	
	B	1	4	3	
5	A	1	3	3	1
	B	1	3	3	1
6	A		2	6	
	B		2	6	
7	A		2	4	2
	B		2	4	2
8	A	1	3	3	1
	B	1	3	3	1
9	A		2	4	2
	B		2	4	2
10	A			4	4
	B			4	4
11	A			6	2
	B			6	2
12	A			5	3
	B			5	3
13	A		1	5	2
	B		1	5	2

– Continued –

TABLE V-1 (Continued)

Number of Wind Directions with Specified Wind Speed

Zone #	Configuration	High	Moderate	Low	Stagnant
		Wind Speed			
14	A		2	2	4
	B		2	2	4
15	A			5	3
	B			5	3
16	A			5	3
	B			5	3
17	A		2	4	2
	B		2	4	2
18	A		3	3	2
	B		3	3	2
19	A	1	2	1	4
	B	1	2	1	4
20	A		2	2	4
	B		2	2	4
21	A		2	4	2
	B		2	4	2
22	A		2	6	
	B		2	6	

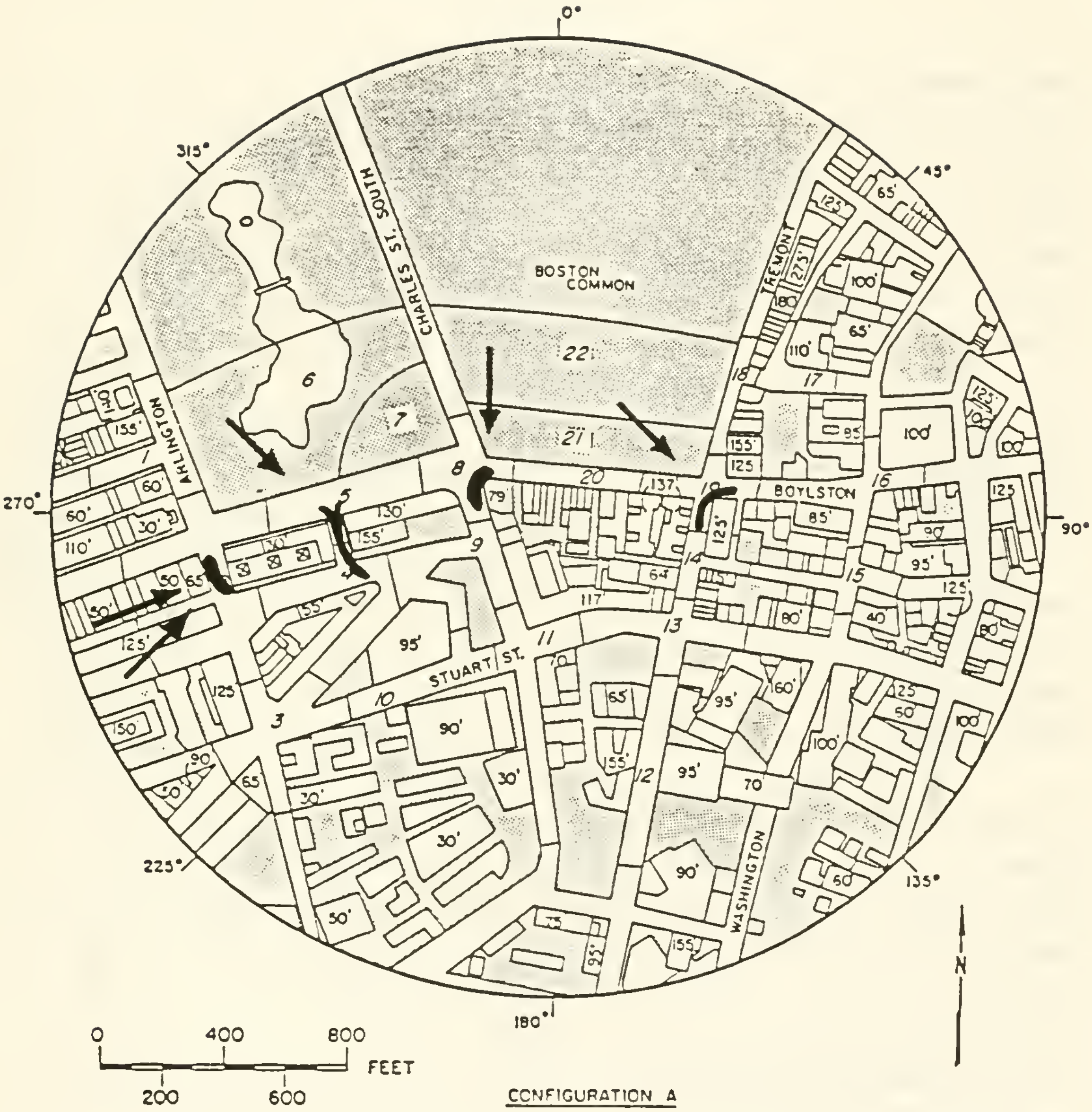


FIGURE V-3 NO-BUILD - HIGH WIND SPEED AREAS AND ASSOCIATED WIND DIRECTIONS

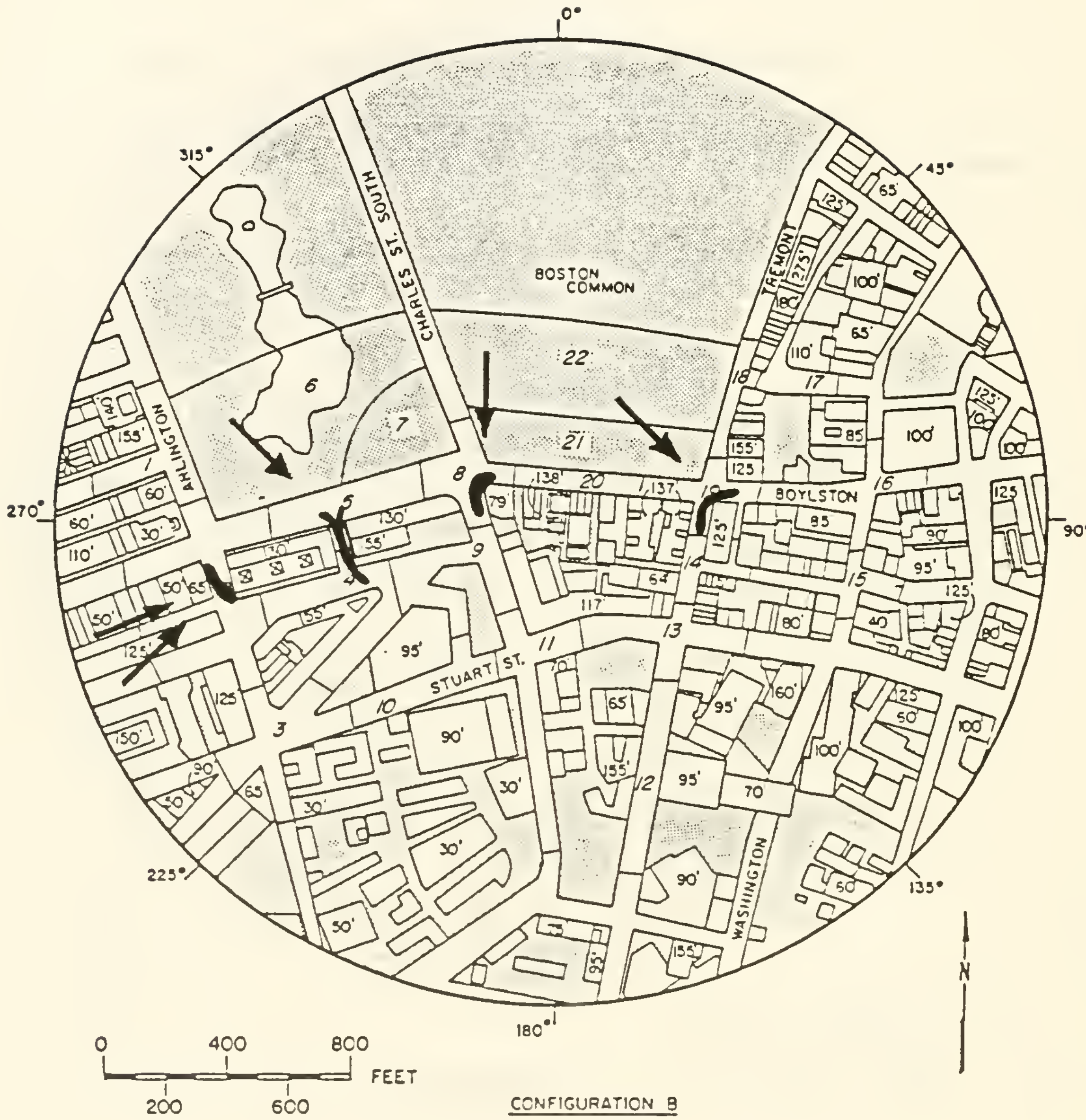


FIGURE V-4 BUILD - HIGH WIND SPEED AREAS AND ASSOCIATED WIND DIRECTIONS

Results and Discussion

The flow visualization study examined pedestrian level winds as described in the previous section. Table V–1 shows the number of wind directions with high, moderate, low or stagnant winds for each of the 22 zones evaluated. Data for both the No–Build configuration (A) and the Build configuration (B) are listed. The table shows that 5 zones had high wind areas. The actual areas where high winds occurred are shown in Figures V–3 and V–4 for the two configurations. The results of Table V–1 and Figures V–3 and V–4 show no observable differences in wind speed between the No–Build and Build configurations.

Figures V–3 and V–4 show 4 areas within 5 zones where smoke velocities were classified as high. Also shown are arrows giving the wind direction for which the high winds were observed. The high winds at Boylston and Arlington were observed for two wind directions while the other three areas were observed only at one wind direction.

Boston Common was modeled as an open area without obstructions, a situation more appropriate during winter when trees are bare than in summer when trees may somewhat reduce wind speeds crossing the Common. This method was used to most appropriately model the season with the strongest winds. Thus, the 3 high wind areas caused by winds crossing the Common may be somewhat lower in speed in the summer months.

None of the 4 high wind areas (within the 5 zones) showed any visible difference in wind speed from No–Build to Build configuration. Because of the qualitative nature of flow visualization, small differences in actual wind speed can occur without visible detection. Some indications of the ability of the 144–150 Boylston project to affect wind speeds in the high wind zones were noted. When winds approach the project site from the north, the same direction which results in a high wind area at Boylston and Charles, the smoke is observed to pass primarily over the site rather than to be deflected along the block thus contributing to additional high winds at the corner. It is likely, on this basis, that the actual magnitude of the high wind area at Boylston and Charles will not be affected by the presence of the 144–150 Boylston project. Similar arguments apply to the other high–wind areas.

The high winds in Zone 8 at the corner of Boylston and Charles occur only for one wind direction, north. The speeds for other wind directions in Zone 8 are split between moderate, low and stagnant wind speeds. Because pedestrian comfort criteria are based on a weighted average over all wind directions, it is probable that the high wind area in Zone 8 is below the BRA guideline of a 31 mph effective peak gust exceeded 1 percent of the time. It is not expected to change due to the 144–150 Boylston project. Thus, that location should remain below the BRA guidelines.

Zone 20 was selected to be on Boylston street immediately in front of and adjacent to the project site. In Table V-1, Zone 20 showed wind speeds that were moderate for 2 directions, low for 2 directions, and stagnant for 4 directions. No differences were observed between the Build and No-Build configurations. The low wind speeds recorded in this zone for both configurations indicate that the one percent effective peak gust will be well below the BRA guidelines of 31 mph and will change by a small amount at most. Thus, addition of the 144-150 Boylston project is not expected to change the local wind environment significantly and will not cause it to approach the BRA guidelines. Similar argument apply to other zones.

Table V-1 shows that no changes were observed in wind speed magnitude in any of the 22 zones examined due to the presence of the 144-150 Boylston project. It is thus concluded that presence of the project will not significantly alter the wind environment in any of the 22 zones.

Because the presence of the project is not expected to significantly change any wind speeds and because wind speeds near the site appear to be well below the BRA guidelines, there is no need to evaluate local winds quantitatively by wind-tunnel test.

1.4 Mitigation

The 144-150 Boylston project is not expected to change wind magnitudes significantly near the site, and no areas near the site are expected to have winds which exceed or approach the BRA guidelines. Therefore, no mitigation measures are required to lower wind speeds near the 144-150 Boylston site.

1.5 Summary

A wind-tunnel test was performed to evaluate the impact of the 144-150 Boylston project on pedestrian wind speeds within 1800 feet of the site. A 1:350 scale model of the project and the surrounding city was installed in a boundary-layer wind tunnel capable of simulating atmospheric winds over the site. Flow visualization studies were conducted using smoke to make the wind visible, to evaluate relative wind speeds, and to identify differences between build and no-build configurations. Flow visualization showed no adverse impact of the building on wind speeds in any area near the building site.

The following conclusions were made:

- o The 144-150 Boylston project will not significantly affect wind speeds in an 1800-foot radius of the site.

- o No area near the site currently has wind speeds which are likely to approach or exceed the BRA guidelines, and the 144-150 Boylston project will not cause any area to approach or exceed the BRA guidelines.

- o Quantitative evaluation of the impact of the 144-150 Boylston project by wind-tunnel test is not required.

- o No mitigation measures are required to lower wind speeds near the 144-150 Boylston site.

REFERENCES

1. Cermak, J.E., "Laboratory Simulation of the Atmospheric Boundary Layer, " AIAA Jl., Vol. 9, September 1971.

2. Cermak, J.E., "Applications of Fluid Mechanics to Wind Engineering," A Freeman Scholar Lecture, ASME Jl. of Fluids Engineering, Vol. 97, No. 1, March 1975.

3. Cermak, J.E., "Aerodynamics of Buildings," Annual Review of Fluid Mechanics, Vol. 8, 1976, pp. 75-106.

2.0 Shadows

2.1 Introduction

The shadow analysis performed for the proposed 144-150 Boylston Street project, outlines those areas that will be shaded by the proposed building during various seasonal and temporal periods. Diagrams have been drawn depicting the horizontal shadows created by buildings on a block of Boylston Street and adjacent buildings across Charles Street to the west and Tremont Street to the east. The shadow diagrams show the existing shadows and the net new shadows that will be created from the project. Net new shadows were calculated using a FAR of 9.8 (proposed building) versus an FAR of 8.0. Differences in the street level shadows between the proposed and alternative building are extremely minor (and in most cases unnoticeable), since the front section of the building is the same in both designs. Most of the changes in shadows occur on rooftops of adjacent buildings. Additional shadows tend to occur with the alternative building, since the highest elevation with that design is enlarged over the proposed design.

Special attention has been paid to the areas most sensitive to shadows - the sidewalks on Boylston Street and the Boston Common, across the street from the project site. The potential impacts of additional shading on the vegetation of the Boston Common are discussed in Section 2.8.

In general, all shadows from individual buildings are short in length during the summer as a result of the higher solar altitude angle. During the vernal and autumnal equinox, shadows extend further from a building's base as the solar altitude angle is less than during the summer. At the same time, the lateral angle through which shadows sweep from morning to evening, decreases from summer to winter.

Shadows for each season were studied as follows: summer solstice (June 22); vernal equinox (March 21); autumnal equinox (September 23); and winter solstice (December 22). For each of these times of year, representative morning (9:00 AM), noon (12:00 PM), and afternoon (3:00 PM) shadow patterns were calculated. Additional shadow analyses were conducted for 10:00 AM, 11:00 AM, 12:00 noon, 1:00 PM, and 2:00 PM on October 21 and November 21 to determine available sunlight on existing sunny public spaces.

2.2 Spring Shadows – March 21 EST

Figures V–5 through V–7 show spring shadows at 9:00 AM, 12:00 noon, and 3:00 PM for March 21. In the morning, existing shadows cover Boylston Street and almost all of its northern and southern sidewalks, and Charles Street and its sidewalks. A very small portion of the Boston Common's southern edge is also shaded. The net new shadow of the project covers a small additional segment of the sidewalk on the north side of Boylston Street. At noon, existing shadows cover almost all of Boylston Street, the sidewalk along its southern edge, and much of the sidewalk along the Boston Common. At noon, the net new shadow covers a segment of Boylston Street adjacent to the site, and a small portion of the Central Burial Ground directly across from the site. At 3:00 PM, the existing shadows cover Boylston and Tremont Streets and their sidewalks and parts of the Boston Common east of the Central Burial Ground. The net new shadow falls on a small section of the sidewalk and Central Burial Ground.

2.3 Summer Shadows – June 22 EDT

Figures V–8 through V–10 show summer shadows at 9:00 AM, 12:00 noon, and 3:00 PM for June 22. In the morning existing shadows lie to the west, covering Charles Street and its sidewalks and some rooftops of adjacent buildings. The shadow from the proposed building will fall only on rooftops. At noon, the existing shadows are very short, reaching only part way across Boylston Street. The net new and existing shadows cover only the sidewalk on the south side of Boylston Street. At 3:00 PM, the existing shadows cover Tremont Street and its sidewalks and the sidewalk on the south side of Boylston Street. The net new shadow from the proposed building falls primarily on adjacent rooftops. None of the net new shadow falls on the Boston Common during the summer.

2.4 Autumn Shadows – September 23 EDT

Figures V–11 through V–13 show autumn shadows at 9:00 AM, 12:00 noon, and 3:00 PM for September 23. The existing morning shadows cover Charles Street, Boylston Street, and Tremont Street. The net new shadow from the proposed building covers a small portion of the Boylston/Charles Street intersection at this time. The remaining net new shadow falls on adjacent rooftops. The existing noon shadows cover most of Boylston Street and its sidewalks. The net new shadow covers an additional section of the sidewalk

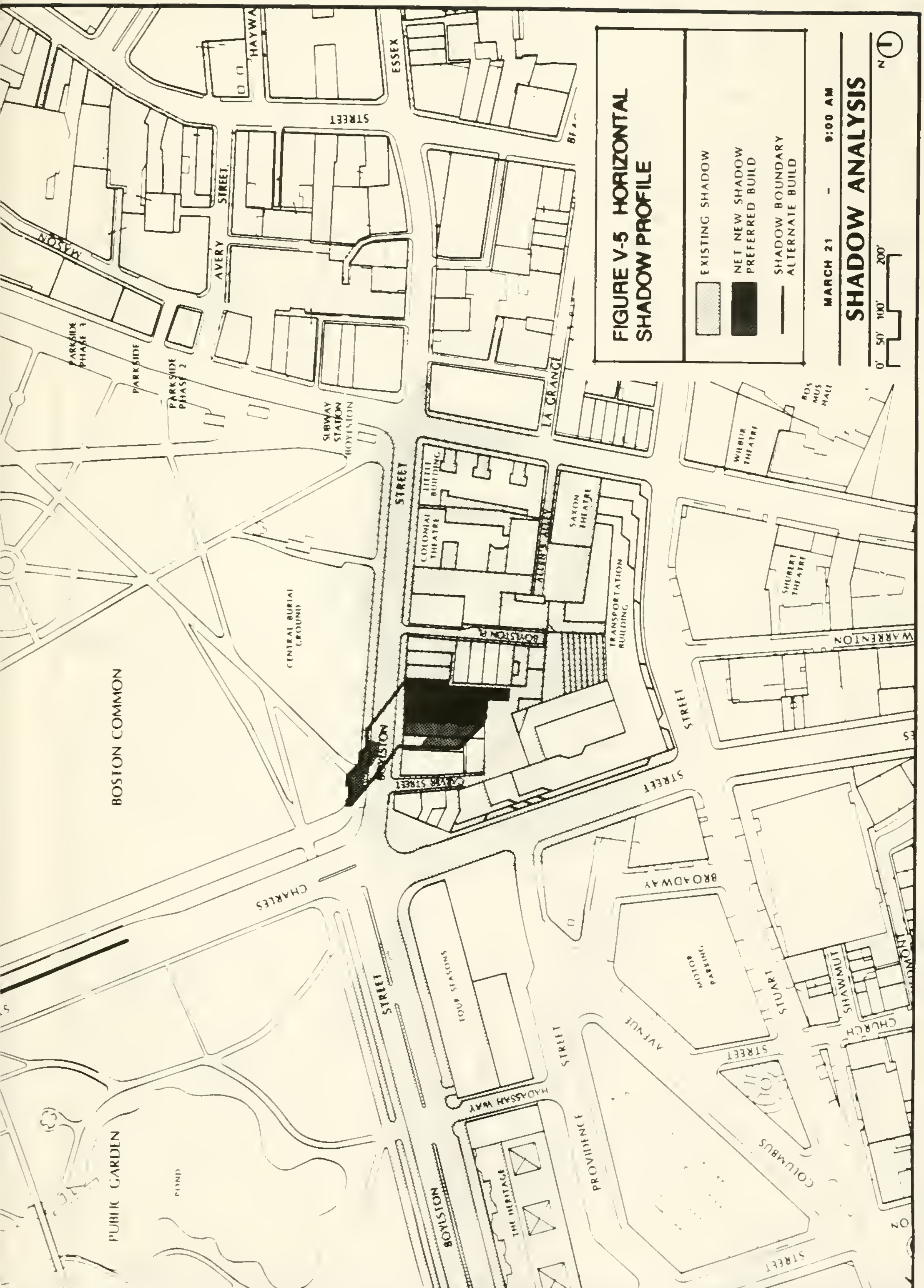


FIGURE V-5 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
MARCH 21 - 9:00 AM
0' 50' 100' 200'
SHADOW ANALYSIS
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
BOYLSTON STREET
CHARLES STREET
TREMONT STREET
ESSEX STREET
AVERY STREET
MASON STREET
LA GRANGE STREET
WARRENTON STREET
STUART STREET
BROADWAY
HADASSAH WAY
PROVIDENCE STREET
COLUMBUS AVENUE
SHAWMUT
CHURCH
PARKSIDE PHASE 1
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
FOUR SEASONS
MOTOR PARKING
THE HERITAGE
BOYLSTON PL.

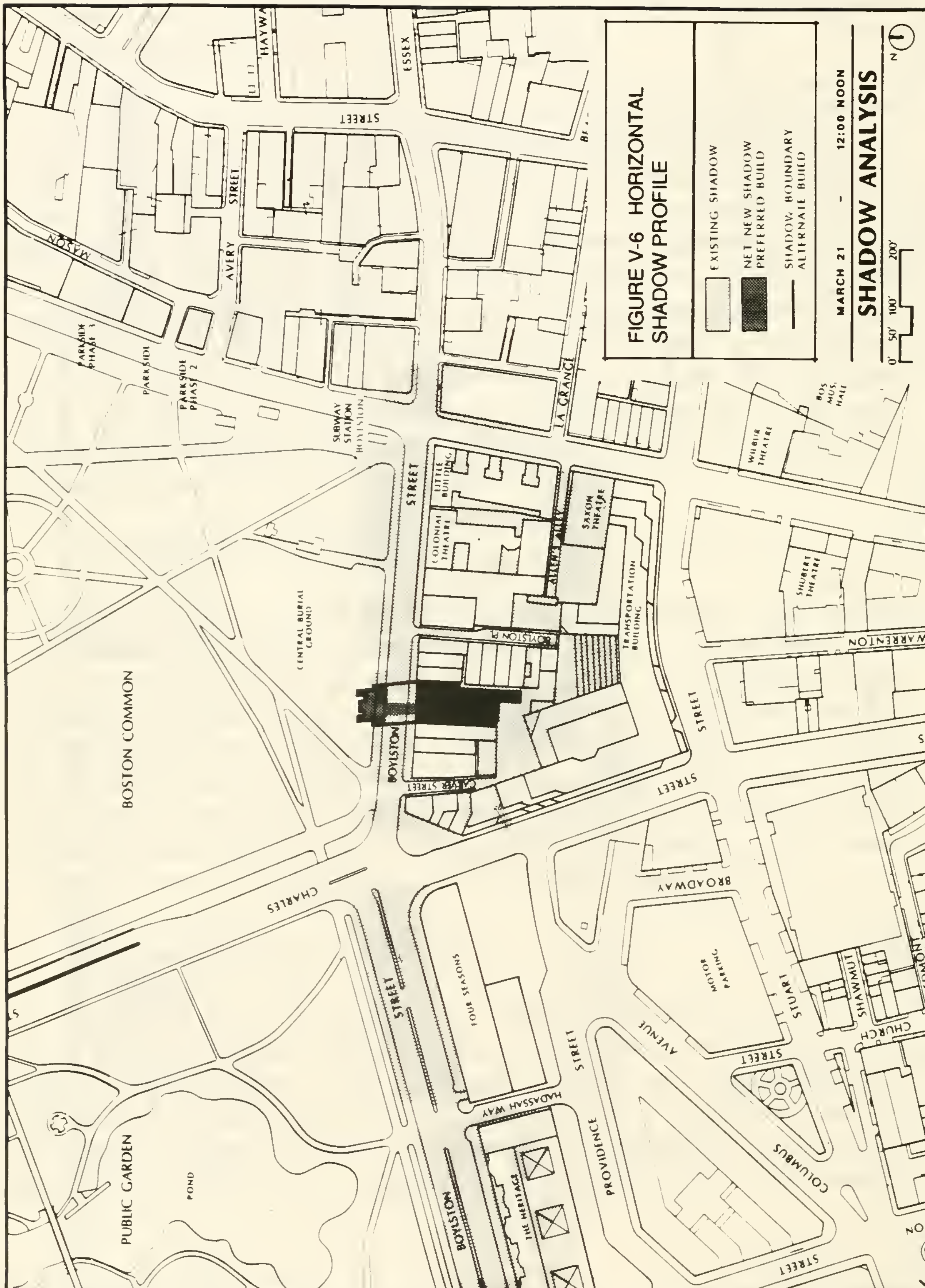


FIGURE V-6 HORIZONTAL
SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW
PREFERRED BUILD
SHADOW BOUNDARY
ALTERNATE BUILD
MARCH 21 - 12:00 NOON
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
MASON
AVERY STREET
HAYWARD
ESSEX STREET
LA GRANGE
BOYLSTON STREET
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
ALLEN'S ALLEY
BOYLSTON PL
TRANSPORTATION BUILDING
CARVER STREET
WILBUR THEATRE
BOS. MUS. HALL
SHUBERT THEATRE
WARRENTON
STREET
CHARLES
BROADWAY
FOUR SEASONS
MOTOR PARKING
STUART
SHAWMUT
CHURCH
HADASSAH WAY
PROVIDENCE STREET
AVENUE
COLUMBUS
THE HERITAGE
BOYLSTON STREET
STREET

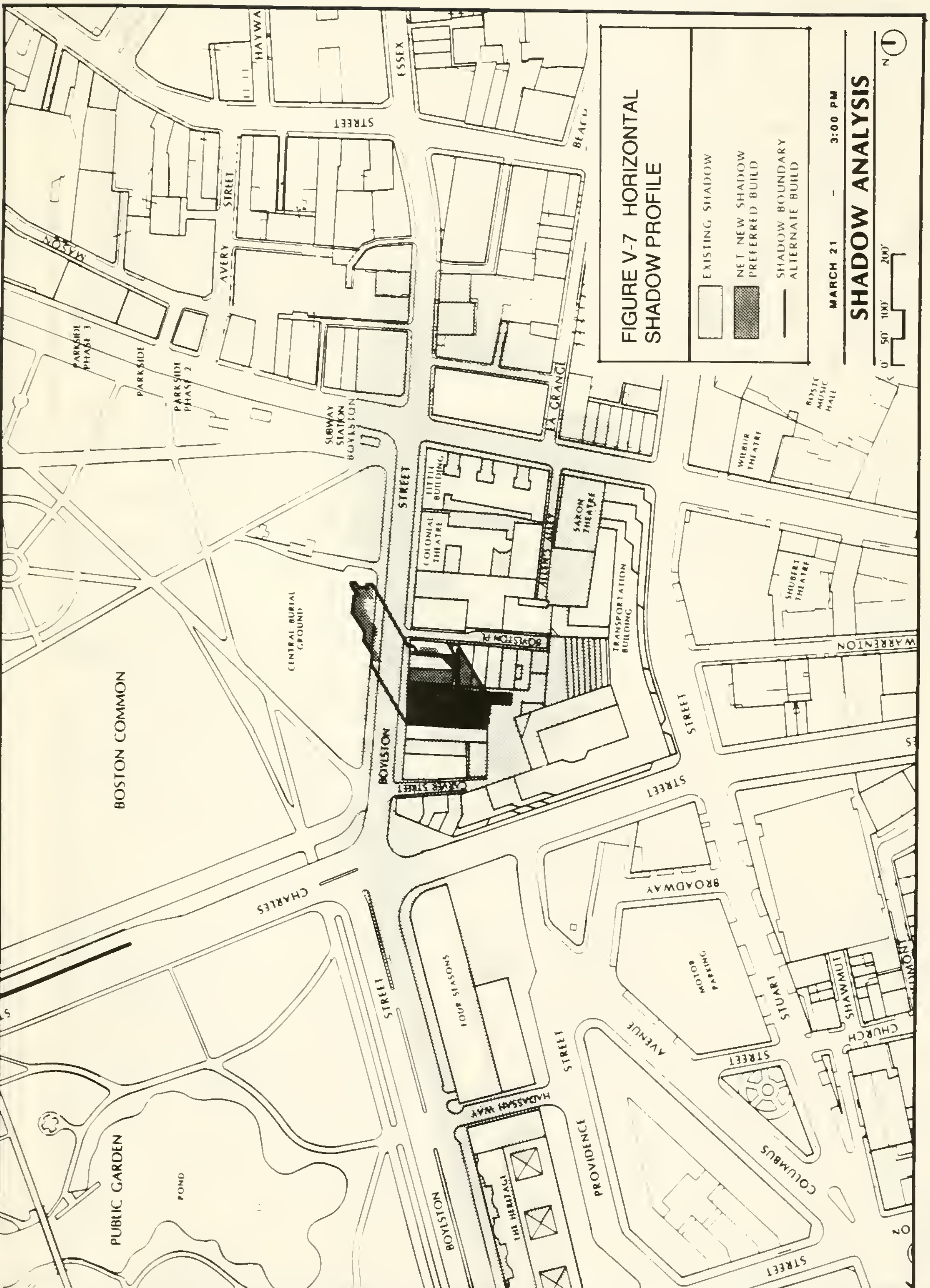


FIGURE V-7 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
MARCH 21 - 3:00 PM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
BOYLSTON
STREET
CHARLES
MASON
AVERY
STREET
ESSEX
STREET
LA GRANGE
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
ALLEN'S ALLEY
BOYLSTON PL
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
BROADWAY
MOTOR PARKING
FOUR SEASONS
HADASSAH WAY
THE HERITAGE
PROVIDENCE
STREET
AVENUE
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STUART
SHAWMUT
CHURCH
STREET

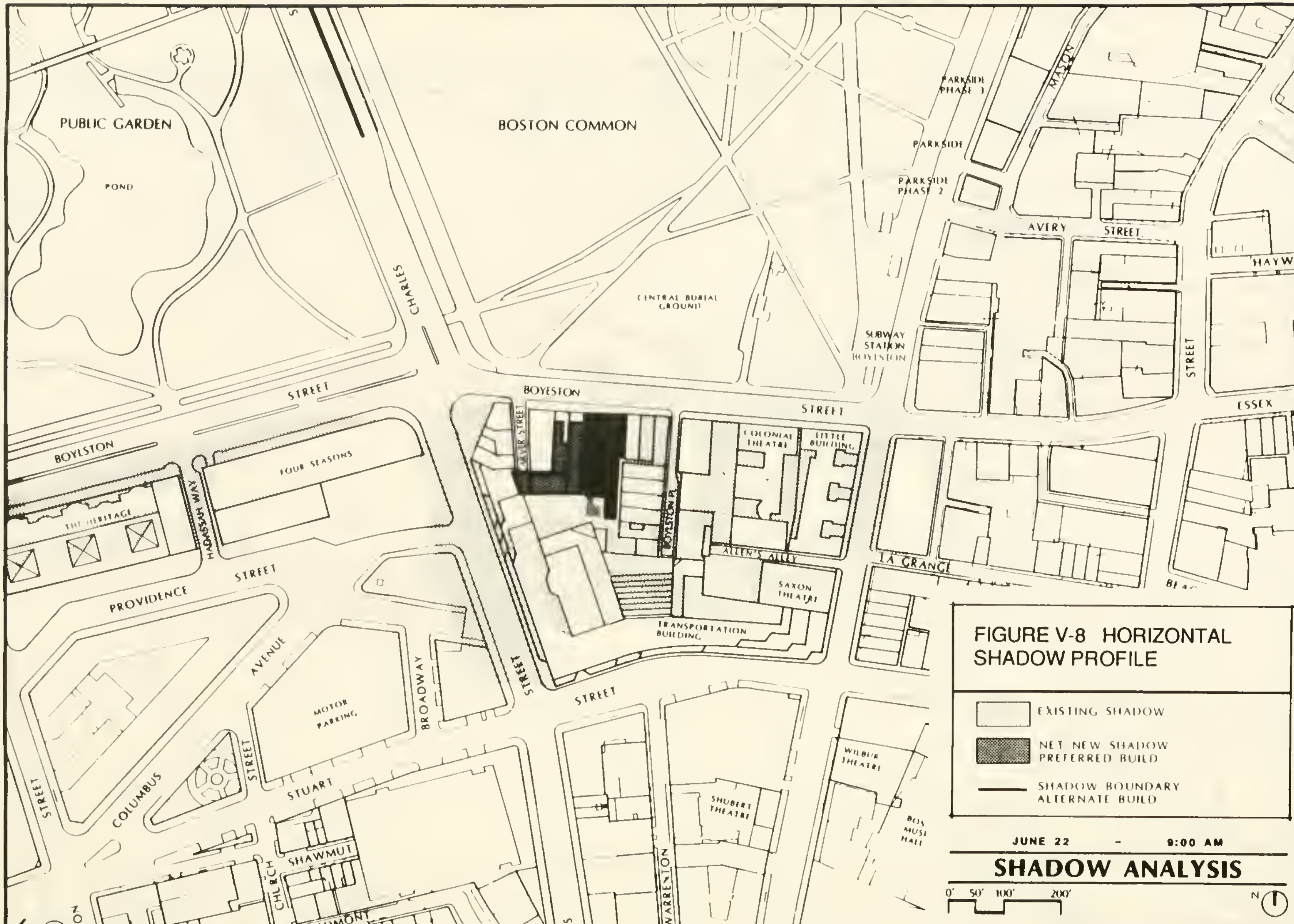

FIGURE V-8 HORIZONTAL SHADOW PROFILE

SHADOW ANALYSIS

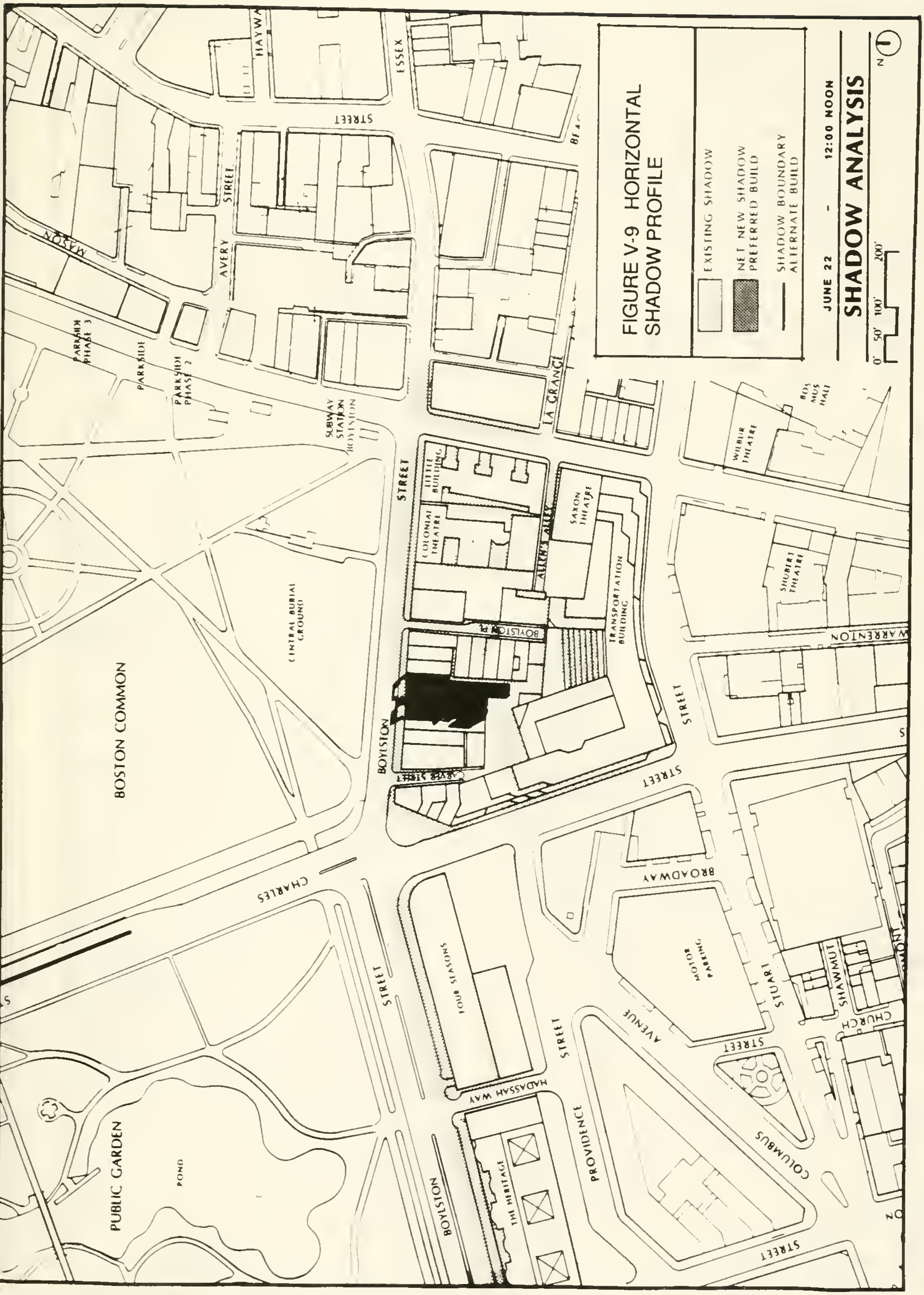
FIGURE V-9 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
JUNE 22 - 12:00 NOON
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
CHARLES
BOYLSTON STREET
TREMONT
MASON
AVERY STREET
ESSEX STREET
LA GRANGE
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
ALLEN'S ALLEY
BOYLSTON PL.
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
STREET
BROADWAY
MOTOR PARKING
STUART
SHAWMUT
CHURCH
STREET
FOUR SEASONS
HADASSAH WAY
PROVIDENCE
AVENUE
COLUMBUS
THE HERITAGE

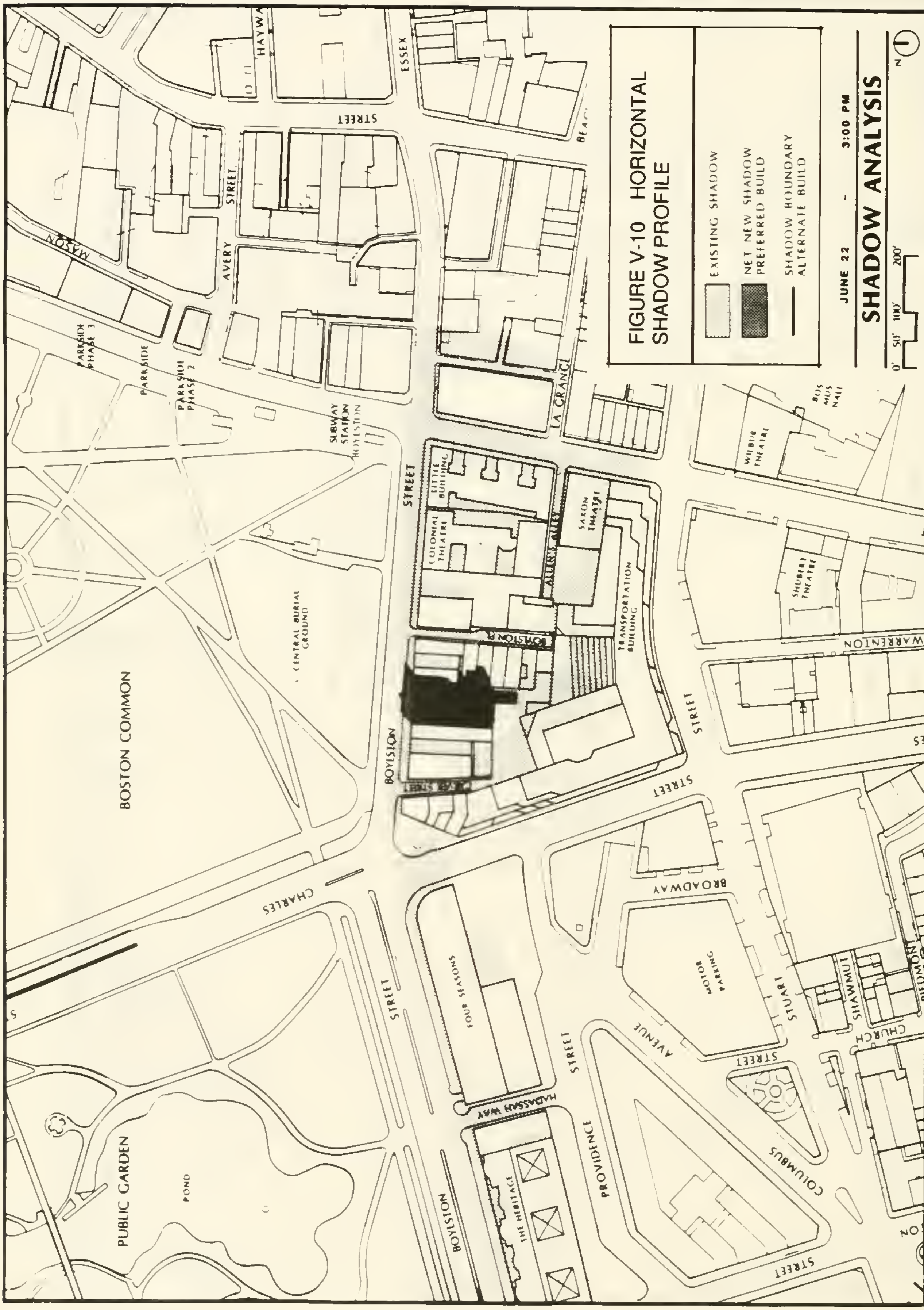
FIGURE V-10 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
JUNE 22 - 3:00 PM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
MASON
AVERY STREET
ESSEX STREET
LA GRANGE
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
BOYLSTON STREET
CHARLES STREET
BROADWAY
FOUR SEASONS
MOTOR PARKING
STUART STREET
SHAWMUT
CHURCH
HADASSAH WAY
PROVIDENCE STREET
AVENUE
COLUMBUS
THE HERITAGE
BOYLSTON
STREET

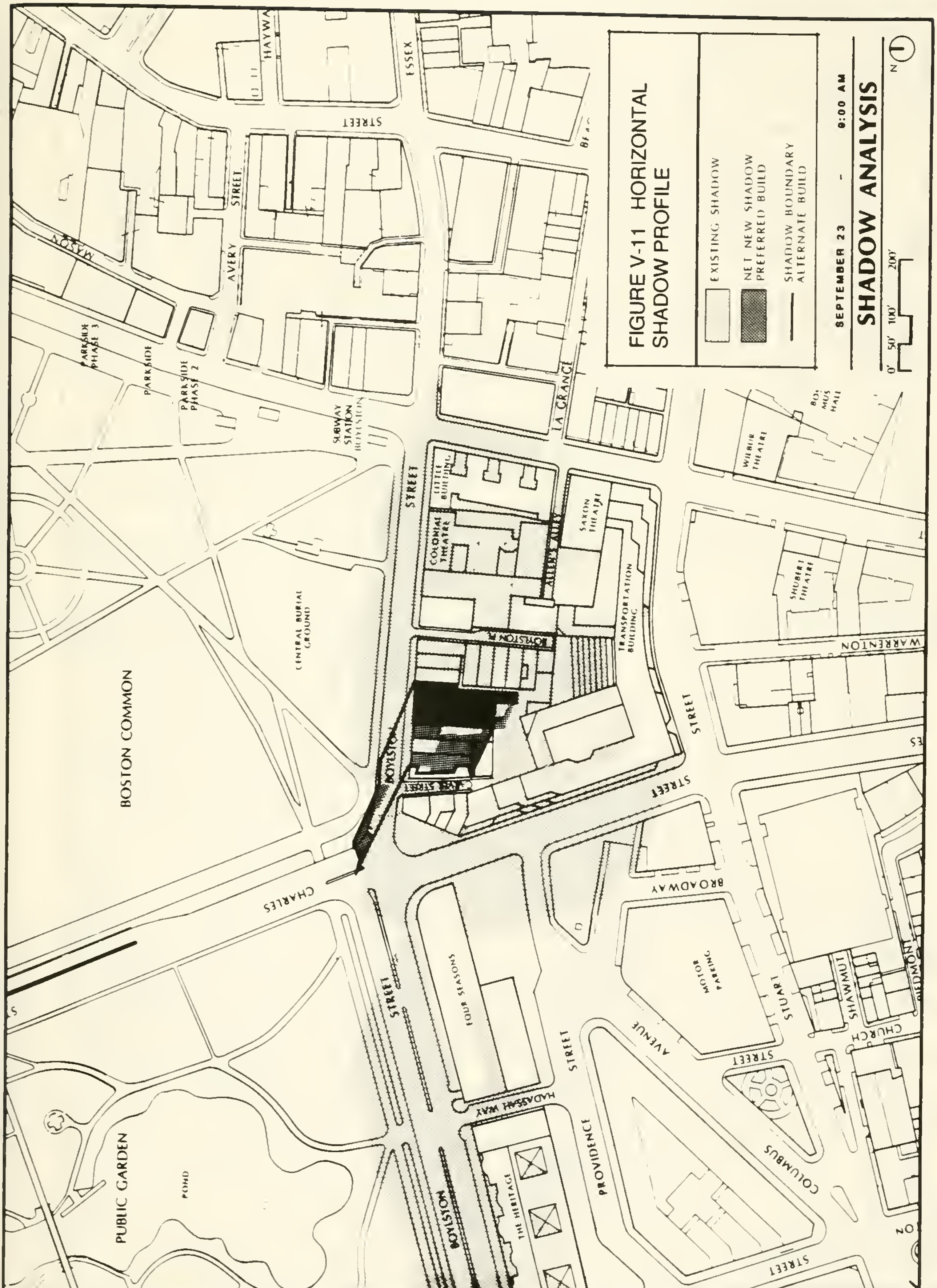
FIGURE V-11 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
SEPTEMBER 23 - 9:00 AM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
CENTRAL BURIAL GROUND
PUBLIC GARDEN
POND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
FOUR SEASONS
THE HERITAGE
MOTOR PARKING
BOYLSTON STREET
CHARLES STREET
BROADWAY
PROVIDENCE STREET
COLUMBUS AVENUE
STUART STREET
SHAWMUT
CHURCH
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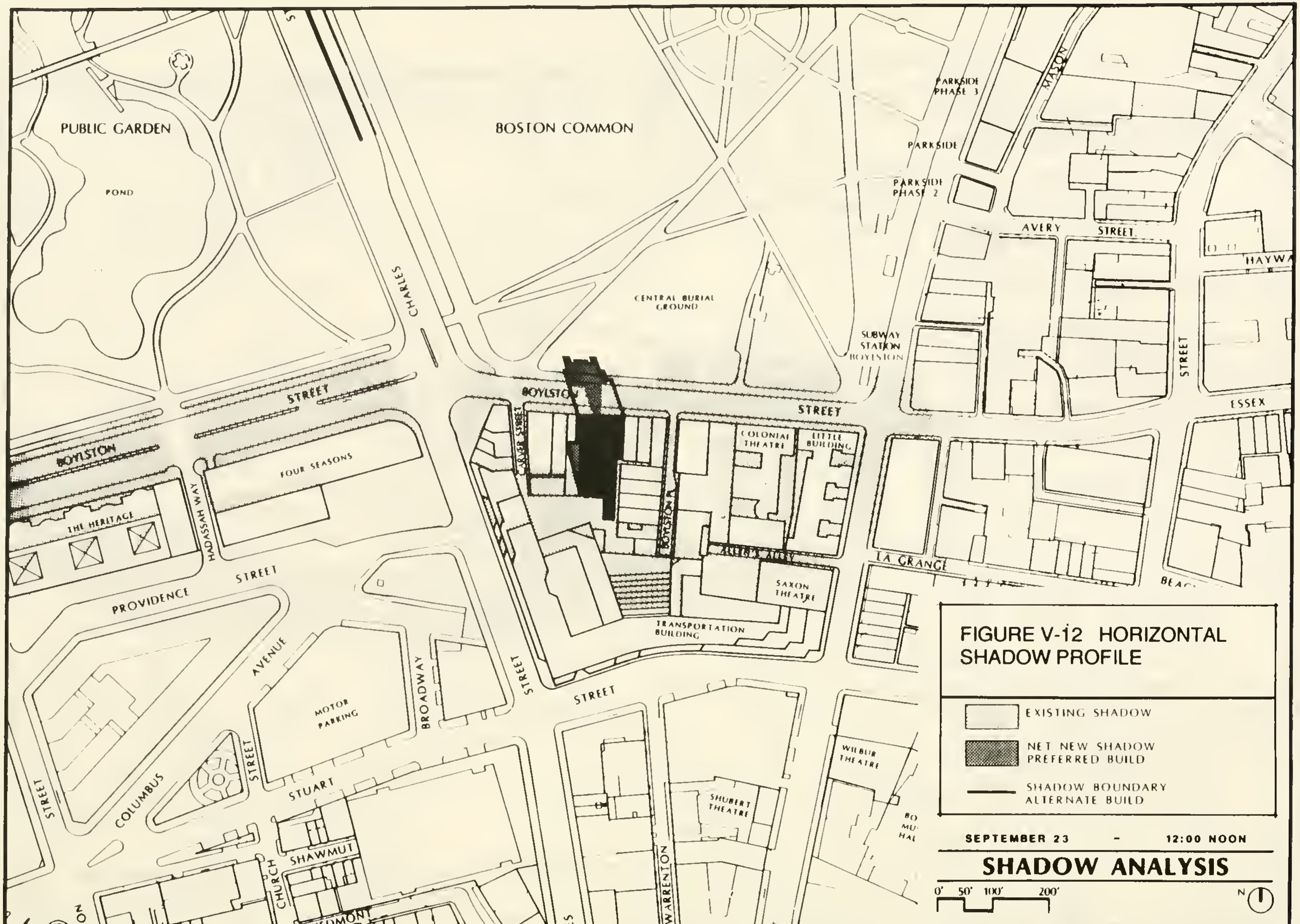
MASON
AVERY STREET
ESSEX STREET
LA GRANGE
HADASSAH WAY
BOYLSTON PL.
ALLEN'S ALLEY


PUBLIC GARDEN
POND
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CENTRAL BURIAL GROUND
CHARLES
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
AVERY STREET
MASON
HAYWA
SUBWAY STATION BOYLSTON
STREET
ESSEX
BOYLSTON STREET
BOYLSTON
FOUR SEASONS
THE HERITAGE
HADASSAH WAY
COLONIAL THEATRE
LITTLE BUILDING
ALLEN'S ALLEY
LA GRANGE
SAXON THEATRE
TRANSPORTATION BUILDING
PROVIDENCE STREET
AVENUE
MOTOR PARKING
BROADWAY
STREET
COLUMBUS
STUART
SHAWMUT
CHURCH
WARRENTON
WILBUR THEATRE
SHUBERT THEATRE
FIGURE V-12 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
SEPTEMBER 23 - 12:00 NOON
SHADOW ANALYSIS
0' 50' 100' 200'
N

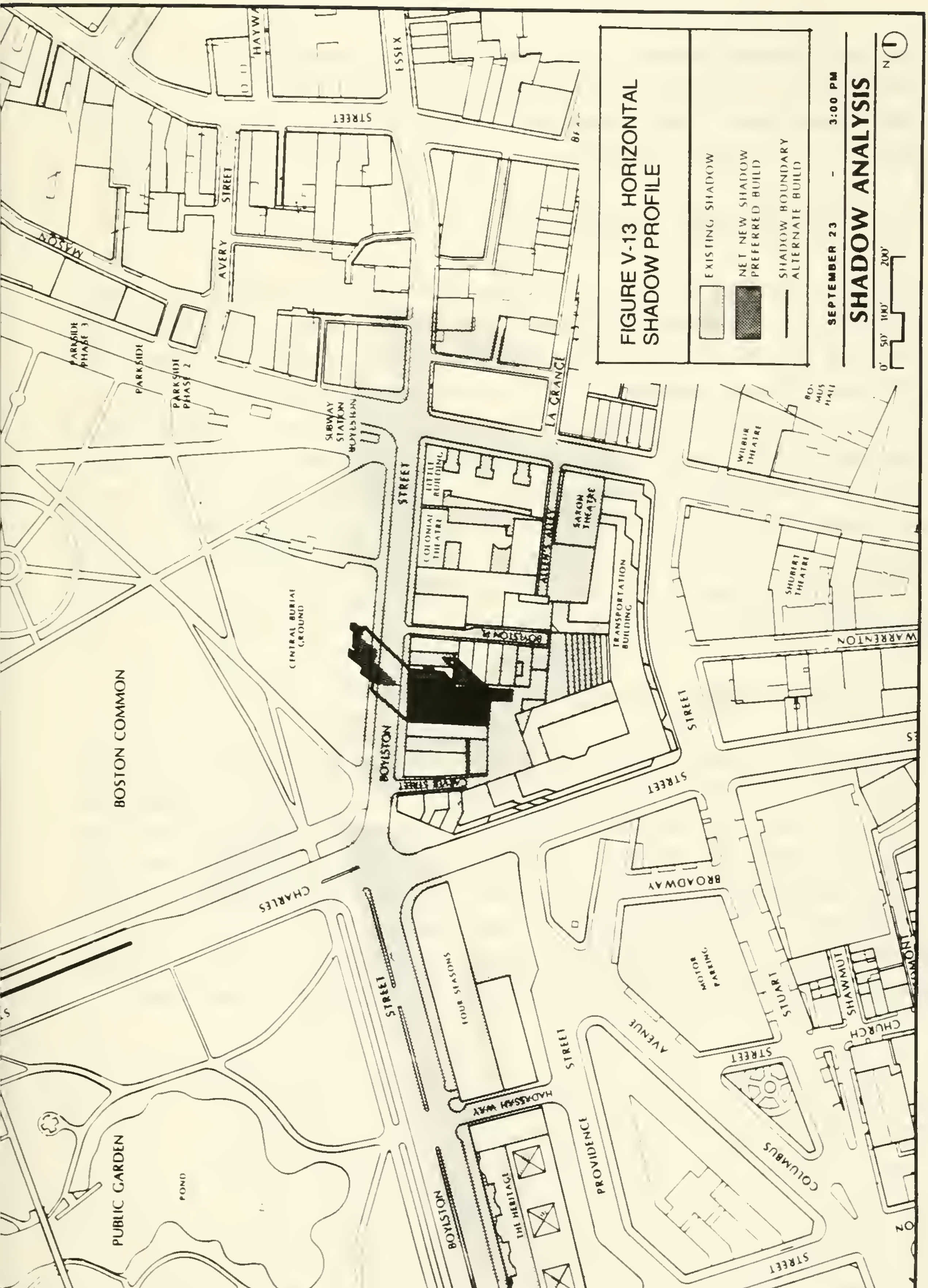
FIGURE V-13 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
SEPTEMBER 23 - 3:00 PM
0' 50' 100' 200'
SHADOW ANALYSIS
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
BOYLSTON STREET
ESSEX STREET
AVERY STREET
MASON
LA GRANGE
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
ALLEN'S ALLEY
TRANSPORTATION BUILDING
BOYLSTON PL
CHARLES
FOUR SEASONS
HADASSAH WAY
THE HERITAGE
PROVIDENCE STREET
BROADWAY
MOTOR PARKING
AVENUE
STUART STREET
SHAWMUT
CHURCH
COLUMBUS
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
STREET

adjacent to the Boston Common and a small part of the Common itself. The 3:00 PM shadows, which cover generally the same area as the noon shadows, are shifted to the east and are slightly longer. Existing shadows reach onto the southern edge of the Boston Common. The net new shadow extends into a small area of the Central Burial Ground.

2.5 Winter Shadows - December 22 EST

Figure V-14 through V-16 show winter shadows at 9:00 AM, 12:00 noon, and 3:00 PM for December 22. The shadows are longest during this time period. In the morning, the Central Burial Ground is completely shaded by existing buildings. Boylston, Charles, and part of Tremont Streets are also shaded. The proposed building adds additional shadows along the western edge of the Boston Common and a portion of Charles Street. At noon, existing shadows extend onto the Boston Common and cover about half of the Central Burial Ground. The project's net new shadow covers an additional portion of the Central Burial Ground and some pedestrian paths on the Boston Common. The 3:00 PM existing shadows cover the largest area of the Boston Common. The Central Burial Ground, Boylston and Tremont Streets are shaded by existing buildings. All of the net new shadow falls on walkways and grassy areas of the Common.

2.6 October Shadows - October 21 EDT

Figures V-17 through V-21 show shadows during October 21, at 10:00 AM, 11:00 AM, 12:00 noon, 1:00 PM, and 2:00 PM. In the morning hours, existing shadows cover Boylston Street, Charles Street, and their sidewalks, about half of the Central Burial Ground, and Boston Common areas just east of the Central Burial Ground. The net new shadow from the proposed building falls on walkways and open areas to the west of the Burial Ground. In the afternoon hours, existing shadows cover Boylston Street and its sidewalks, and some areas of the Boston Common including a portion of the Central Burial Ground. The net new shadow also falls on the Central Burial Ground and a segment of Boylston Street.

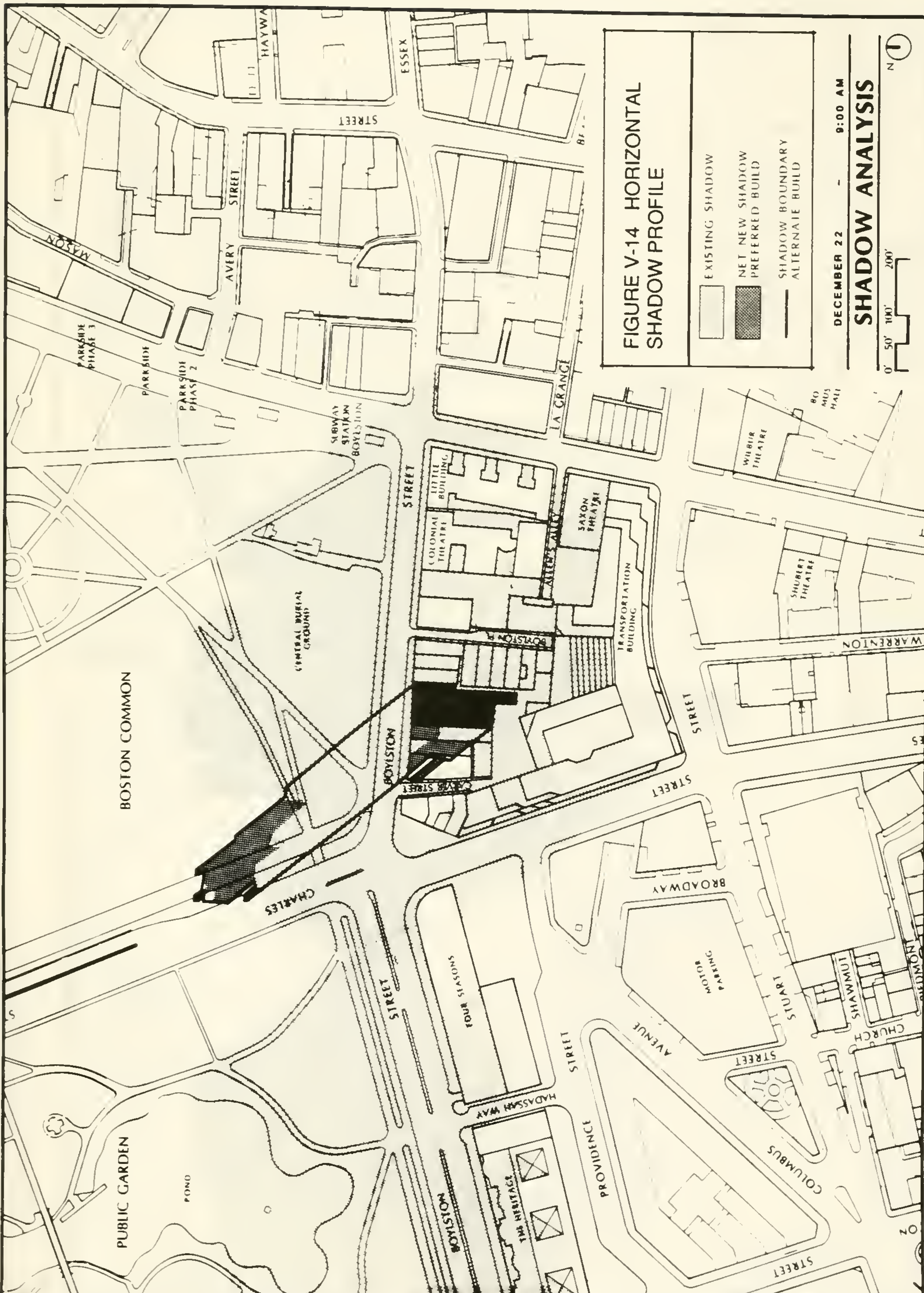
FIGURE V-14 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
DECEMBER 22 - 9:00 AM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
BOYLSTON STREET
CHARLES STREET
TREMONT STREET
AVERY STREET
MASON STREET
ESSEX STREET
LA GRANGE
BOYLSTON SUBWAY STATION
PARKSIDE PHASE 1
PARKSIDE
PARKSIDE PHASE 2
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
ALLENS ALLEY
TRANSPORTATION BUILDING
BOYLSTON PL
CARVER STREET
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
BROADWAY
STUART STREET
MOTOR PARKING
SHAWMUT
CHURCH
FOUR SEASONS
HADASSAH WAY
THE HERITAGE
PROVIDENCE STREET
COLUMBUS AVENUE

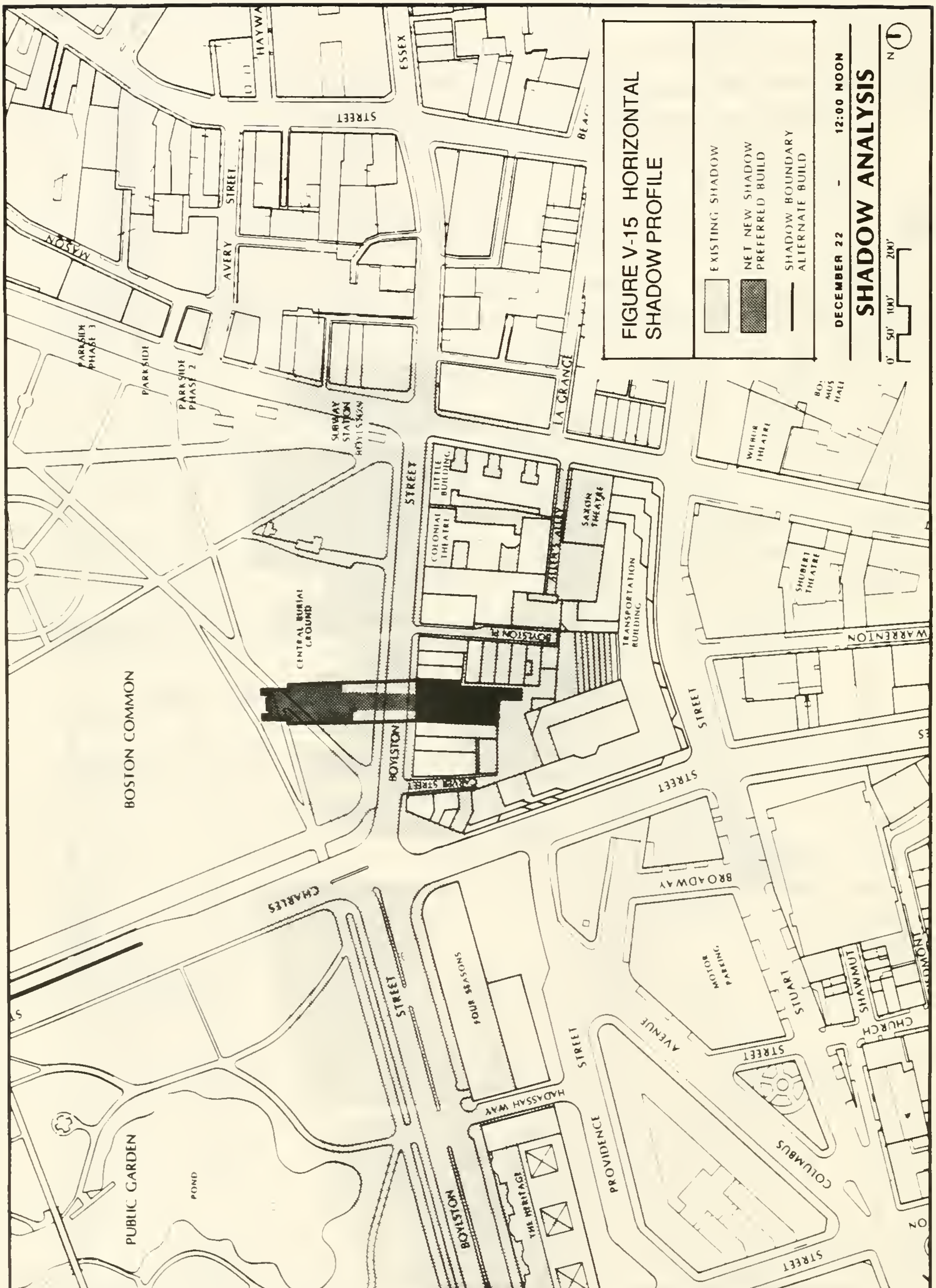

FIGURE V-15 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
DECEMBER 22 - 12:00 NOON
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
MASON
AVERY STREET
ESSEX STREET
LA GRANGE
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
TRANSPORTATION BUILDING
BOYLSTON PL
CARVER STREET
BOYLSTON STREET
CHARLES STREET
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
BROADWAY
STUART STREET
MOTOR PARKING
SHAWMUT
CHURCH
COLUMBUS AVENUE
PROVIDENCE STREET
HADASSAH WAY
FOUR SEASONS
THE HERITAGE

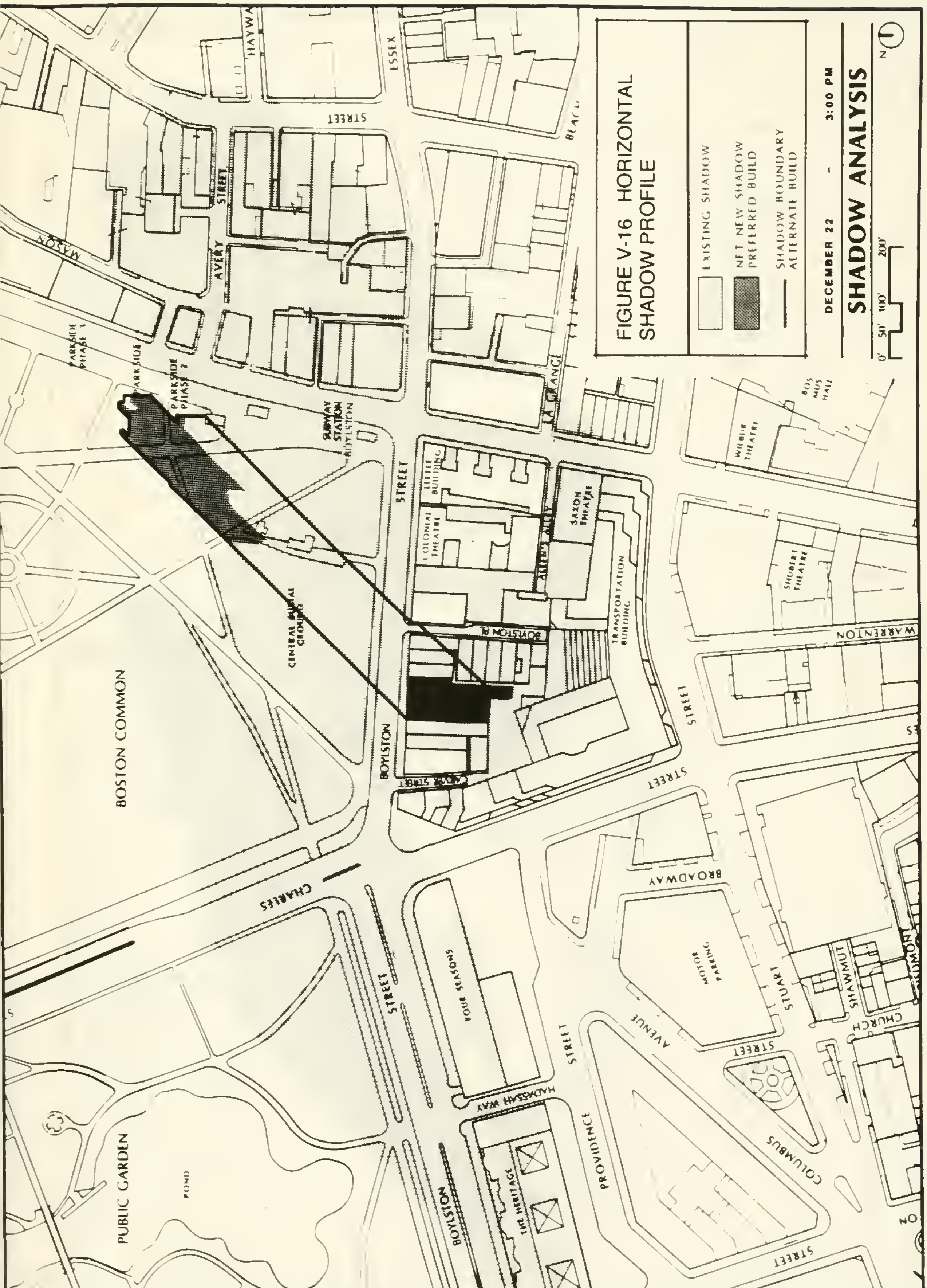
FIGURE V-16 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
DECEMBER 22 - 3:00 PM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
CHARLES
BOYLSTON STREET
BOYLSTON
STREET
TREMONT
AVERY STREET
MASON
ESSEX
STREET
PARKSIDE PHASE 1
PARKSIDE PHASE 2
PARKSIDE
SUBWAY STATION BOYLSTON
COLONIAL THEATRE
LITTLE BUILDING
SAXON THEATRE
TRANSPORTATION BUILDING
BOYLSTON PL
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
STREET
BROADWAY
MOTOR PARKING
STUART STREET
SHAWMUT
CHURCH
COLUMBUS
AVENUE
PROVIDENCE STREET
HADASSAH WAY
FOUR SEASONS
THE HERITAGE
STREET

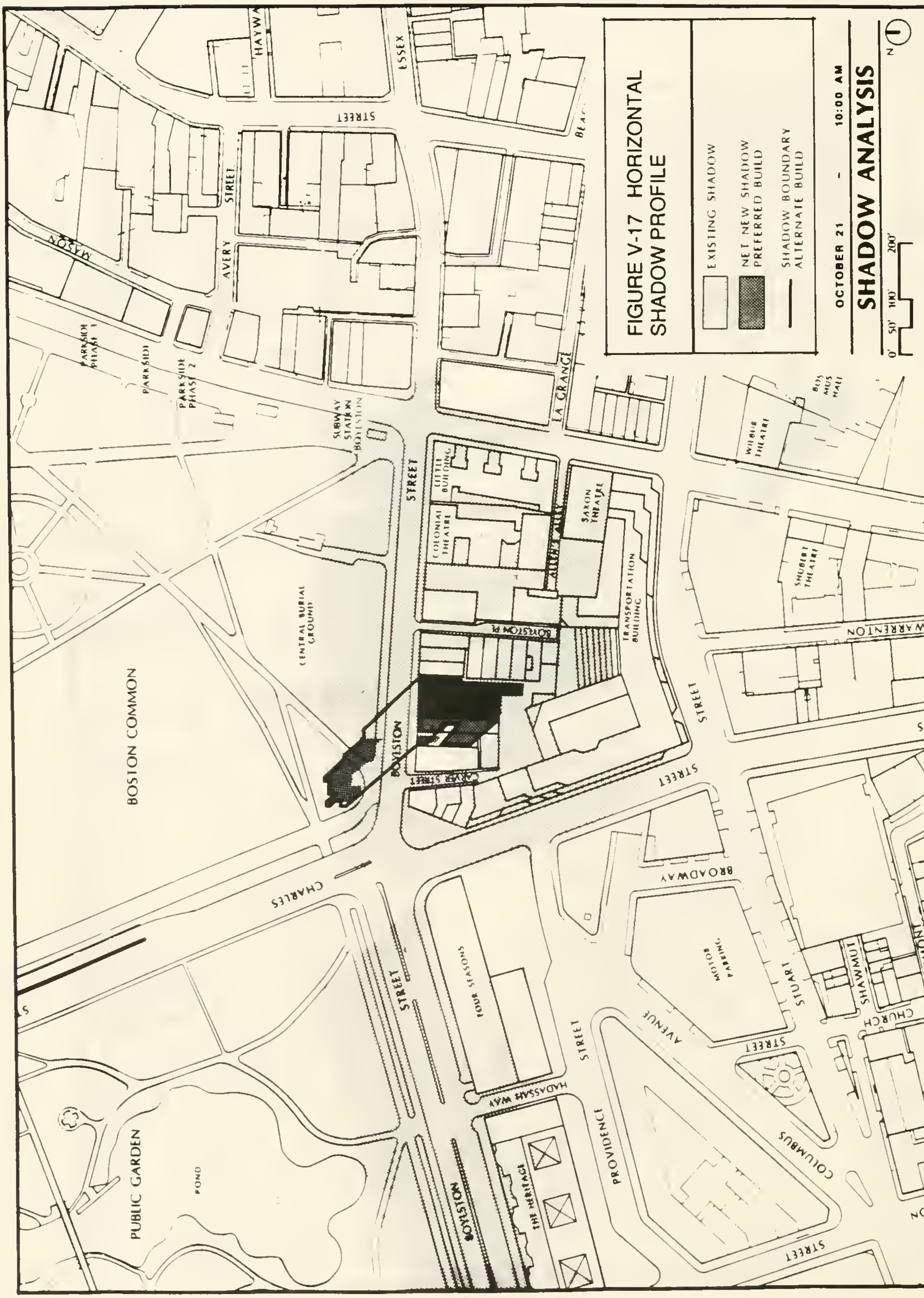
FIGURE V-17 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
OCTOBER 21 - 10:00 AM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
CENTRAL BURIAL GROUND
PUBLIC GARDEN
POND
PARKSIDE PHASE 1
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
MASON
AVERY
STREET
ESSEX
STREET
LA GRANGE
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
BOYLSTON PL
BOYLSTON
STREET
CHARLES
STREET
BROADWAY
MOTOR PARKING
FOUR SEASONS
HADASSAH WAY
STREET
PROVIDENCE
THE HERITAGE
BOYLSTON
AVENUE
STUART
STREET
SHAWMUT
CHURCH
COLUMBUS
STREET

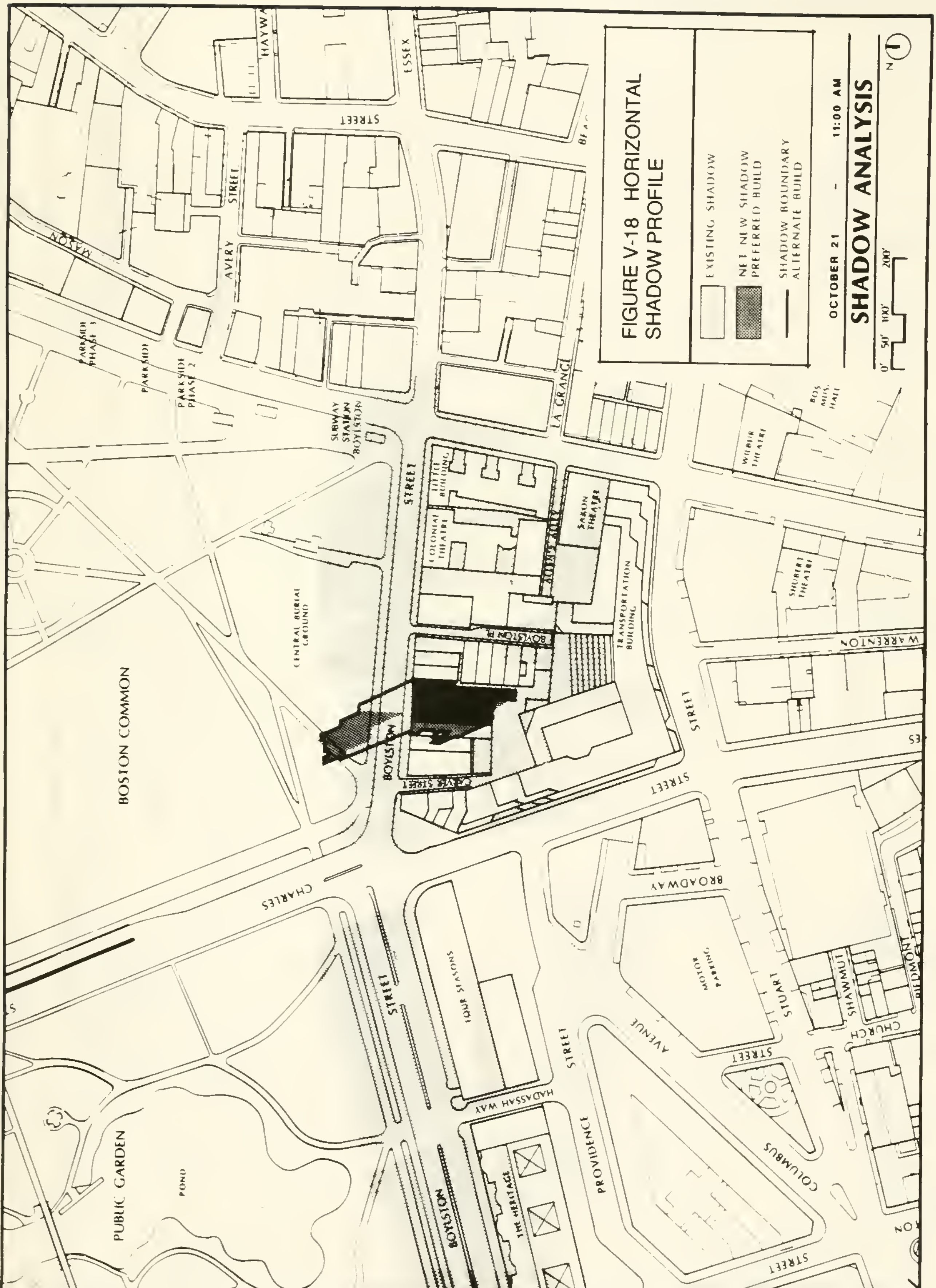
FIGURE V-18 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
OCTOBER 21 - 11:00 AM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 1
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
BOYLSTON STREET
STREET
AVERY STREET
MASON
ESSEX STREET
LA GRANGE
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
ALLEN'S ALLEY
BOYLSTON PL
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
CHARLES STREET
BROADWAY
FOUR SEASONS
HADASSAH WAY
THE HERITAGE
PROVIDENCE STREET
MOTOR PARKING
STUART STREET
COLUMBUS AVENUE
SHAWMUT
CHURCH STREET
PIEDMONT

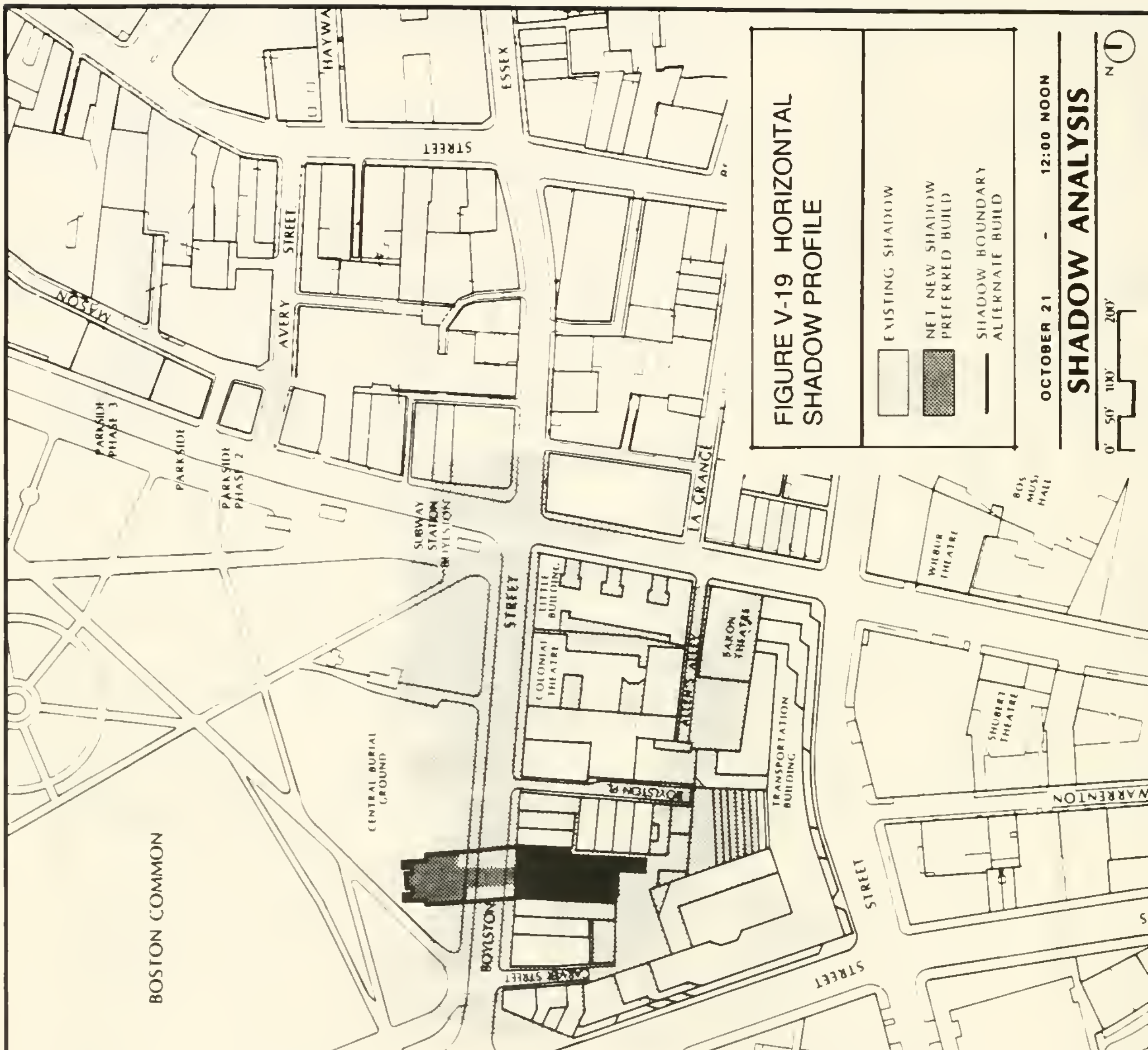

FIGURE V-19 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
OCTOBER 21 - 12:00 NOON
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
LITTLE BUILDING
COLONIAL THEATRE
BARON THEATRE
ALLEN'S ALLEY
TRANSPORTATION BUILDING
BOYLSTON PL.
WILBUR THEATRE
SHUBERT THEATRE
FOUR SEASONS
MOTOR PARKING
THE HERITAGE
MASON
AVERY STREET
ESSEX STREET
LA GRANGE
BOYLSTON STREET
CHARLES
WARRENTON
BROADWAY
STUART
SHAWMUT
CHURCH
COLUMBUS AVENUE
PROVIDENCE STREET
HADASSAH WAY

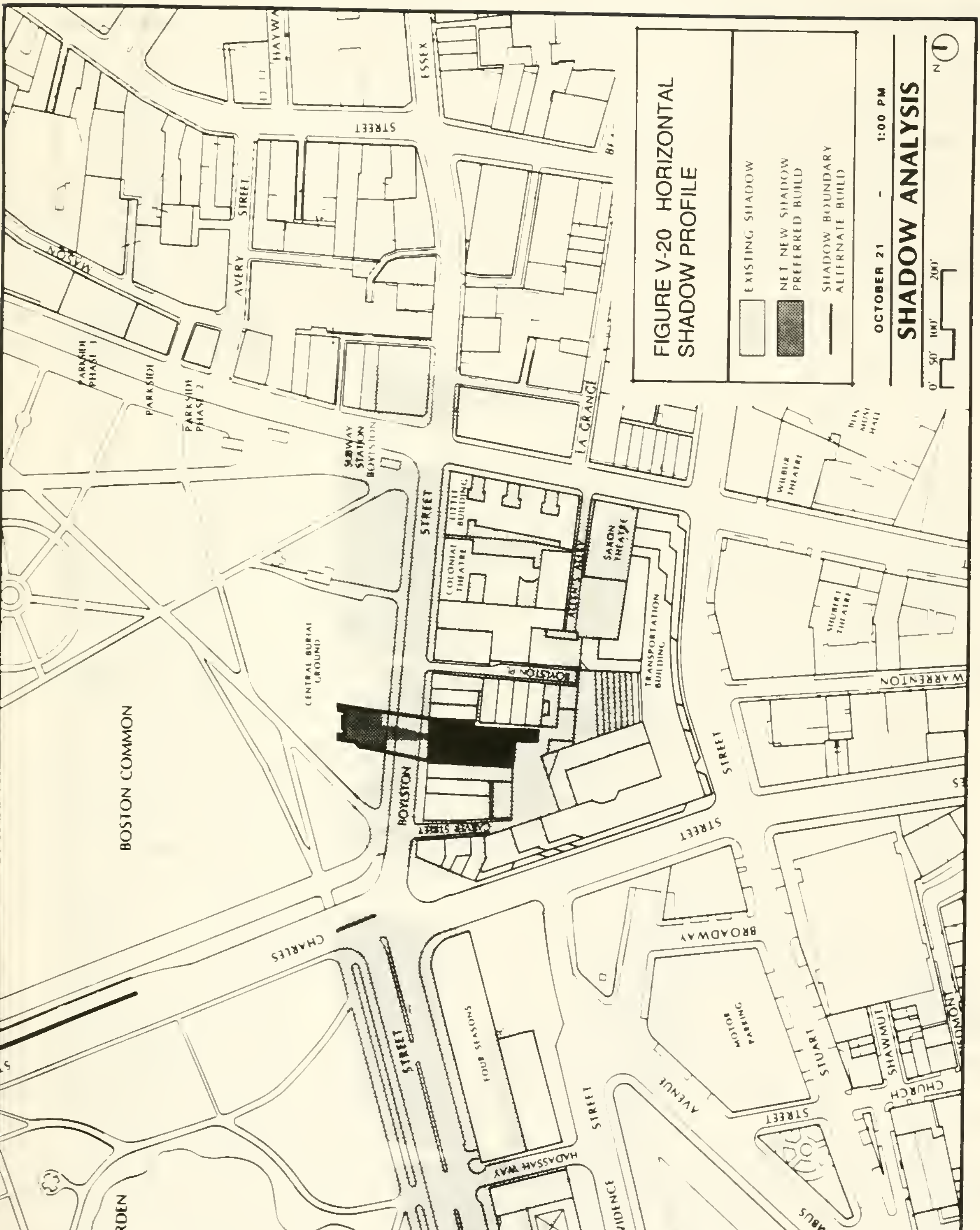
FIGURE V-20 HORIZONTAL
SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW
PREFERRED BUILD
SHADOW BOUNDARY
ALTERNATE BUILD
OCTOBER 21 - 1:00 PM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
BOYLSTON STREET
CHARLES STREET
AVERY STREET
MASON
ESSEX STREET
LA GRANGE
PARKSIDE PHASE 1
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
BOYLSTON PL.
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
BROADWAY
MOTOR PARKING
STUART STREET
SHAWMUT
CHURCH
FOUR SEASONS
HADASSAH WAY
PROVIDENCE STREET
AVENUE
COLUMBUS
THE HERITAGE

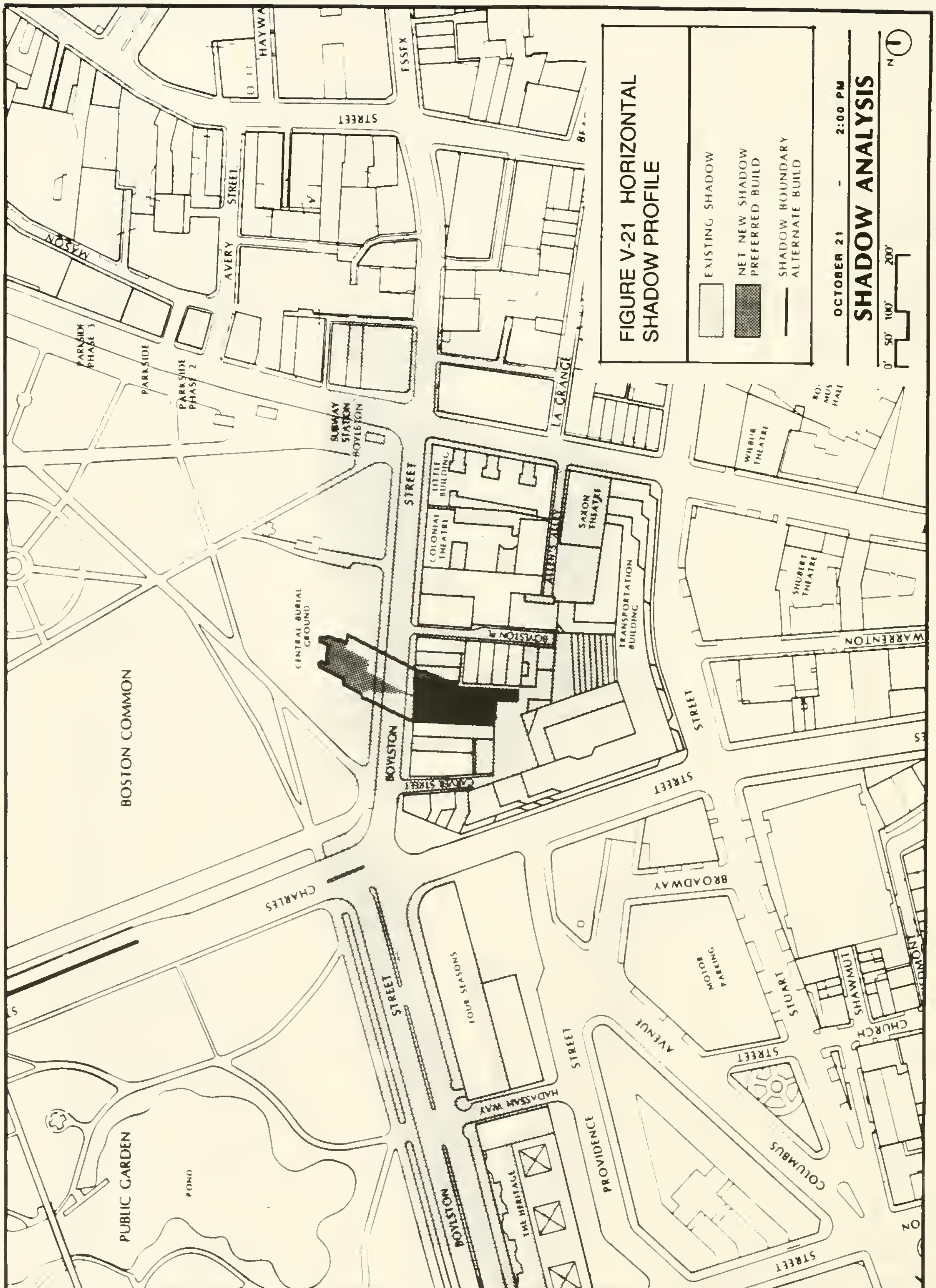

FIGURE V-21 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
OCTOBER 21 - 2:00 PM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
FOUR SEASONS
MOTOR PARKING
THE HERITAGE
BOYLSTON STREET
CHARLES STREET
ESSEX STREET
AVERY STREET
MASON
LA GRANGE
BOYLSTON PL
CAROL STREET
WARRENTON
BROADWAY
STUART STREET
SHAWMUT
CHURCH
COLUMBUS AVENUE
PROVIDENCE STREET
HADASSAH WAY

2.7 November Shadows – November 21 EST

Figures V–22 through V–26 show the November 21 shadows at 10:00 AM, 11:00 AM, 12:00 noon, 1:00 PM, and 2:00 PM. The existing and net new shadow from the proposed building follow the same pattern as the October shadows. The main difference is the length of the shadows which extend further onto the Boston Common during November. The net new shadow falls on some open areas and walkways to the west of the Central Burial Ground in the morning, and on the Central Burial Ground and part of Boylston Street in the afternoon.

2.8 Effects of Additional Shading on Boston Common Vegetation

The effects of new shadows associated with the proposed building on the vegetation of Boston Common has been analyzed to identify potential impacts and to allow for the development of any necessary mitigating measures. Areas receiving new shadows during the growing season, from mid–April to mid–October, were determined from the shadow study. An inventory of the existing and proposed vegetation and light environments in these areas was conducted and the tolerance of the plant species to shade evaluated.

Three planted areas lie within the shadows cast by the proposed building (see Figure V–27). The first area is located northeast of the intersection of Charles Street and Boylston Street. Approximately 1,000 square feet will receive additional shading during early mornings and late evenings until early April and after September. Currently, the area is partially shaded by existing buildings and mature trees. A portion of this area has been planted with shrubs of yew (Taxus canadensis), azalea (Rhododendron sp.), small flower beds, and a large area of grass.

Both yew and azalea are shade tolerant, with yew requiring shade in the winter. The increase in shade for two to three hours a day for a limited period of time will have no effect on their productivity and development. Neither the flower beds nor the grass would be affected by this change, as the flowers planted are generally summer blooming and the grass does not require constant sun. Vegetation which is currently shaded by existing buildings appears healthy and tolerates the seasonal shading.

The second area is surrounded by foot paths and contains three black locust trees (Robinia pseudacacia) and an English elm (Ulmus procera) growing on the periphery of the projected new shadow. Grass grows at the base of the trees. Locust trees are known for their tolerance of extreme environmental conditions and would not be affected by the new shadow, occurring only from mid–September through the end of the growing season. The

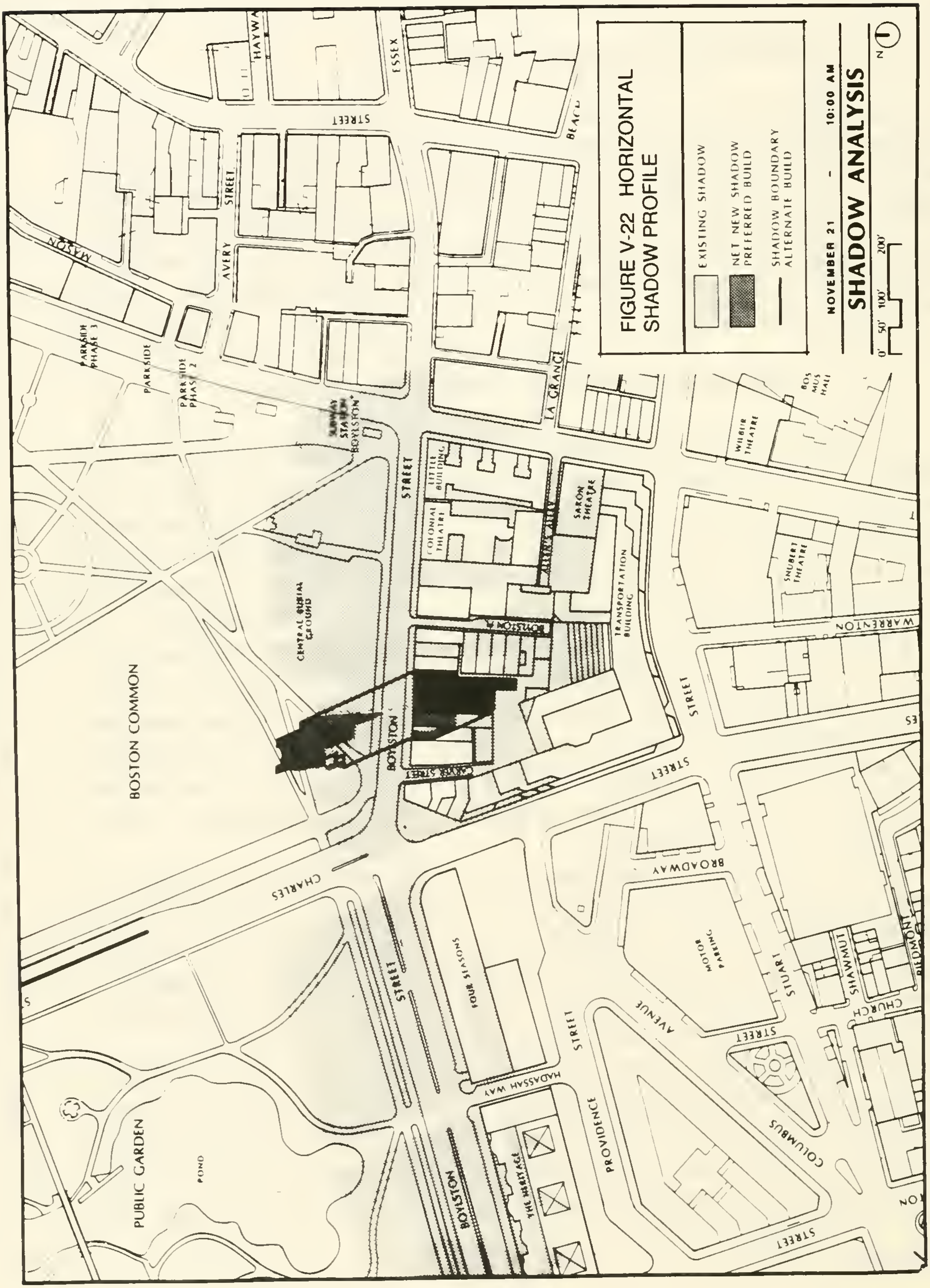

FIGURE V-22 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
NOVEMBER 21 - 10:00 AM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
FOUR SEASONS
MOTOR PARKING
THE HERITAGE
MASON
AVERY STREET
ESSEX STREET
LA GRANGE
BOYLSTON STREET
CHARLES
CARVER STREET
BOYLSTON PL
WARRENTON
BROADWAY
STUART STREET
SHAWMUT
PIEDMONT
CHURCH
COLUMBUS AVENUE
PROVIDENCE STREET
HADASSAH WAY

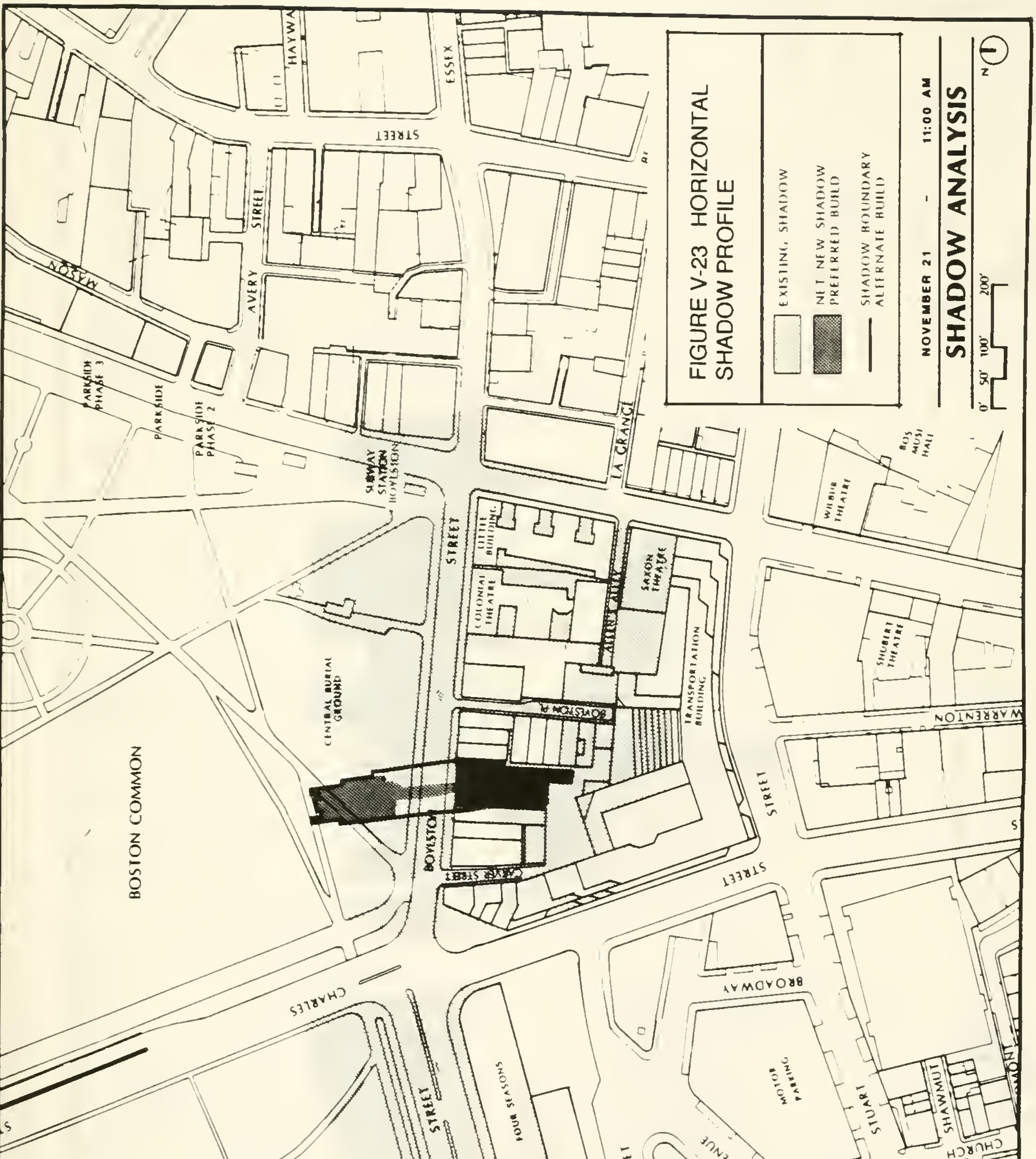

FIGURE V-23 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
NOVEMBER 21 - 11:00 AM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
MASON
AVERY STREET
ESSEX STREET
LA GRANGE
BOYLSTON STREET
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
ALLENS ALLEY
BOYLSTON PL
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
WARRENTON
STREET
CHARLES STREET
BROADWAY
MOTOR PARKING
STUART STREET
SHAWMUT
CHURCH
FOUR SEASONS
HADASSAH WAY
PROVIDENCE STREET
AVENUE
COLUMBUS
BOYLSTON
THE HERITAGE

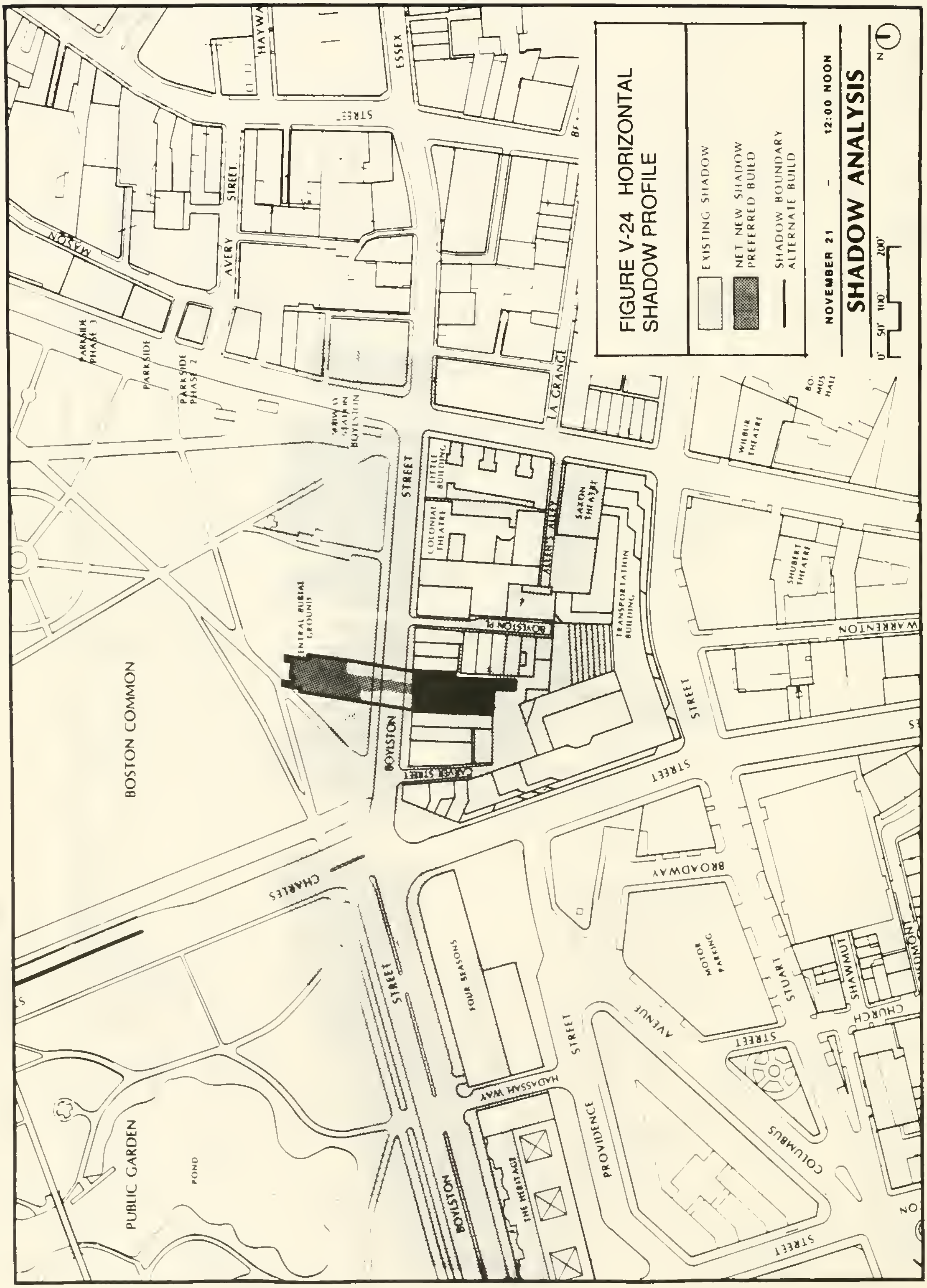

FIGURE V-24 HORIZONTAL SHADOW PROFILE

SHADOW ANALYSIS

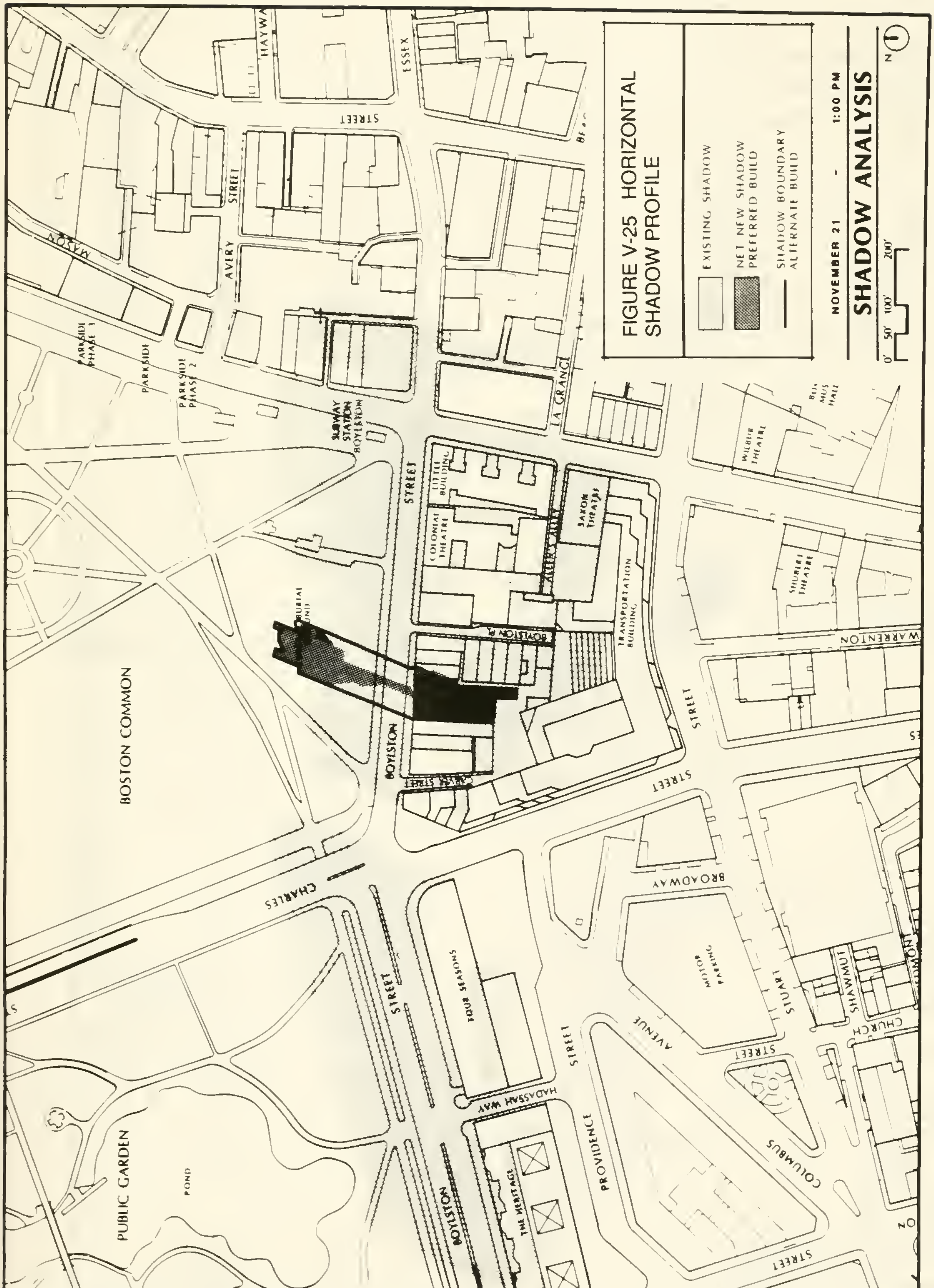
FIGURE V-25 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
NOVEMBER 21 - 1:00 PM
SHADOW ANALYSIS
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
BOYLSTON STREET
CHARLES STREET
ESSEX STREET
AVERY STREET
MASON
LA GRANGE
WARRENTON
BROADWAY
STUART
SHAWMUT
CHURCH
COLUMBUS
PROVIDENCE STREET
HADASSAH WAY
FOUR SEASONS
THE HERITAGE
MOTOR PARKING
TRANSPORTATION BUILDING
COLONIAL THEATRE
LITTLE BUILDING
SAXON THEATRE
WILBUR THEATRE
SHUBERT THEATRE
SUBWAY STATION BOYLSTON
PARKSIDE PHASE 1
PARKSIDE
PARKSIDE PHASE 2
BOYLSTON PL.
AVERY STREET
AVENUE

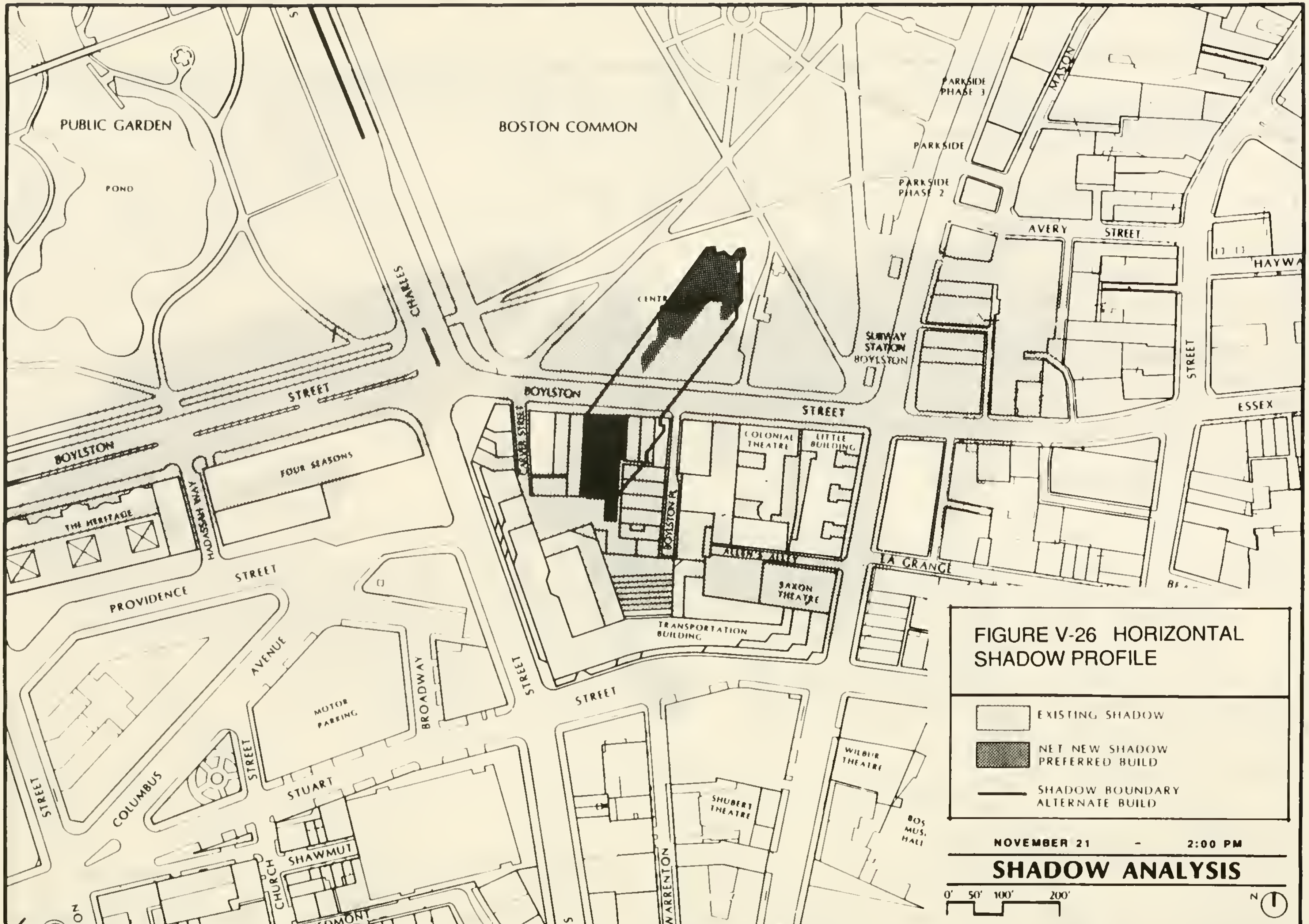
FIGURE V-26 HORIZONTAL SHADOW PROFILE
EXISTING SHADOW
NET NEW SHADOW PREFERRED BUILD
SHADOW BOUNDARY ALTERNATE BUILD
NOVEMBER 21 - 2:00 PM
SHADOW ANALYSIS
0' 50' 100' 200'
N
PUBLIC GARDEN
POND
BOSTON COMMON
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
MASON
AVERY STREET
ESSEX
STREET
SUBWAY STATION BOYLSTON
CHARLES
BOYLSTON STREET
FOUR SEASONS
THE HERITAGE
HADASSAH WAY
CARVER STREET
BOYLSTON PL
COLONIAL THEATRE
LITTLE BUILDING
ALLEN'S ALLEY
SAXON THEATRE
LA GRANGE
TRANSPORTATION BUILDING
PROVIDENCE STREET
AVENUE
COLUMBUS
MOTOR PARKING
BROADWAY
STUART
SHAWMUT
CHURCH
PIEDMONT
WARRENTON
SHUBERT THEATRE
WILBUR THEATRE
BOS. MUS. HALL

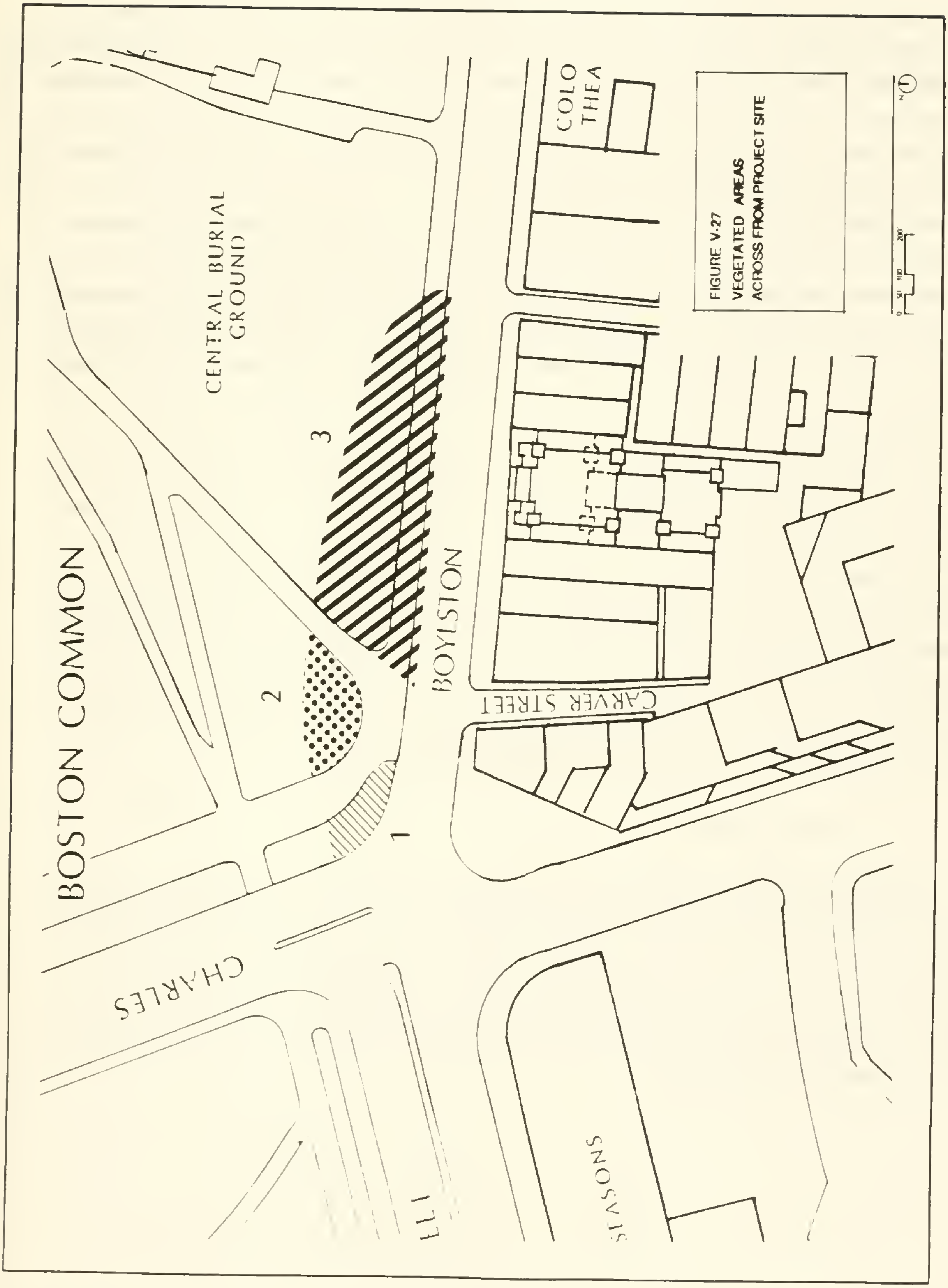

FIGURE V-27
VEGETATED AREAS
ACROSS FROM PROJECT SITE

mature elm tree is greater than 12 meters in height and would undergo little change in total yearly insolation. Upper branches and the entire north face of the tree would not receive any additional shading. Grasses in the area are generally tolerant of shading, although some decline is evident beneath the closed canopies of the existing mature trees. No change in the grasses would be expected because of the limited decrease in insolation associated with the proposed project.

The third area consists of the Central Burial Ground and the areas immediately adjacent to it. New shade will occur from the beginning of the growing season until late May, and from early September through the end of the growing season. Some vegetation would be shaded throughout the day, although any given point would receive additional shade for only a limited period. Basswood (Tilia cordata) has been evenly planted along Boylston Street and throughout the Burial Ground. These trees are now 30 to 40 centimeters in diameter at breast height and have grown to a height of approximately 10 meters. Scattered lilacs (Syringa sp.) have been planted beneath the mature trees, and grass and weeds grow in the unpaved areas. The basswoods will continue to receive sunlight for long periods throughout the year. Trees closest to Boylston Street may exhibit increased growth on the northern face of their canopy and some thinning to the south as a result of the increased shade, however, the effects of this on growth and productivity will be insignificant. Full sun during June, July, and August will ensure that complete, healthy canopies are maintained. The shrubs and grasses currently grow in near total shade created by the existing mature trees and buildings. A limited increase in shade for only two to three months would have no affect on them.

2.9 Summary of Impacts

The shadow diagrams indicate that most of the net new shadows associated with the proposed building will be limited to Boylston Street and its sidewalks and the southern portion of the Boston Common, particularly the Central Burial Ground since it is immediately north of the site across Boylston Street. Much of the net new shadow across Boylston Street is due to the fact that the building which once stood on the middle parcel of the site, is no longer standing.

The longest shadows will be cast during December, mostly on the Boston Common. December, however, is not a time of heavy use for the Common, with pedestrians being primarily in transit. In addition, this new shading occurs at a time when extensive existing shadows already intrude on the Boston Common. During spring and fall, some new shadows will be cast on the Common and its walkways, but these are minor compared to the shadows which are already cast by the existing buildings surrounding the area.

Vegetation in the affected area is currently shaded by existing buildings and mature trees during the early and late portions of the growing season. The proposed building will result in only a slight increase in total shade. Because of this minor increase, there will be no significant impacts on the Boston Common vegetation associated with this construction, and no mitigation measures appear necessary.

3.0 Air Quality

3.1 Objective

The objective of this analysis is to verify that, with construction of the proposed 144-150 Boylston Street project, the Massachusetts and National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO) will be maintained. These standards, established by the Federal Clean Air Act, are designed to protect public health and welfare. To demonstrate compliance, it is necessary to identify those areas of human activity (sensitive receptors) exposed to maximum air pollutant levels from motor vehicle emissions in the project area. Using air quality modeling techniques, CO levels are estimated at these sensitive receptors with and without the proposed project. Comparison of projected pollutant levels to the NAAQS permits an evaluation of whether motor vehicle emissions will pose a threat to public health.

3.2 Pollutant Sources and Effects

Of the six pollutants regulated by the NAAQS, four are emitted by motor vehicles or formed from their emissions: carbon monoxide (CO), nitrogen oxides (NO_x), ozone (O_3), and lead (Pb). CO is used in this analysis as an indicator of roadway air pollution levels, since it is the most abundant and persistent pollutant emitted by motor vehicles. Further, its nonreactive properties allow pollutant transport and dispersion to be modeled.

NAAQS for carbon monoxide have been set by the U.S. Environmental Protection Agency (EPA). Standards for the Commonwealth of Massachusetts are identical to the Federal standards. Primary standards which exist for CO are intended to protect the public health. The primary CO standards set a maximum concentration of 35 parts per million (ppm) for a one-hour period, and 9 ppm for eight hours, each not to be exceeded more than once per year.

3.3 Background Air Quality

Background levels reflect the contribution of all sources in the project area less the specific intersections analyzed. Existing background levels of CO were recommended by the Massachusetts Department of Environmental Quality Engineering (DEQE) to be 5.0

ppm (1-hour average), and 3.0 ppm (8-hour average).* These values were also assumed for future years in the analysis.

3.4 Study Approach

The 144-150 Boylston Street air quality analysis was based on BRA** and DEQE* recommended procedures. The analysis calculated maximum one-hour and eight-hour CO concentrations at sensitive receptors located adjacent to two key intersections in the project area for the following three cases:

Case No.	Year	Project Alternative
1	1988	Existing
2	1990	No-Build
3	1990	Build

For each case, the EPA MOBILE3*** and EPA Regions I and IV CALQ3**** computer programs were used to calculate motor vehicle emissions and CO concentrations at intersections. Emissions data calculated by the MOBILE3 model were based on motor vehicle operating conditions typical of peak one-hour and eight-hour periods. In addition, the analysis incorporated the effects of the Commonwealth's statewide inspection and maintenance (I&M) program designed to control emissions of CO from motor vehicles. These emissions data were used as input to the CALQ3 model to predict CO concentrations. MOBILE3 and CALQ3 modeling and assumptions are detailed in Appendix C.

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* Personal Communication, Mr. Michael Scherer, DEQE, Boston, MA, July 22, 1988.

** Personal Communication, Mr. Richard Mertens, Boston Redevelopment Authority (BRA), July 26, 1988.

*** EPA, User's Guide to MOBILE3: Mobile Source Emissions Model, EPA-460/3-84-002, Ann Arbor, MI, June 1984.

**** EPA Region I, "CALQ3 Modeling Procedures", January 1, 1986.

An additional analysis was performed to determine impacts of the project's proposed parking facility. The analysis of the parking garage utilized the EPA MOBILE3 Computer Program and Volume 9 Guidelines* to generate emissions data. This information was used as input to Halitsky's gas diffusion equation to calculate CO impacts at receptors studied in the intersection analysis. These calculations are also provided in Appendix C.

Since CO emissions are greatest at roadway intersections due to vehicle idling, acceleration and deceleration, sensitive receptors in close proximity to project area intersections were selected. The air quality analysis examined CO levels at the following two intersections within the study area:

- o Boylston Street/Tremont Street
- o Boylston Street/Charles Street

In addition, air quality at two receptors located between the two intersections were examined. These receptors are located at the proposed building entrance and at a cafe on Boylston Place, a pedestrian walkway connecting Boylston Street and the State Transportation Building. CO impacts from both intersections and the garage were examined at these receptors.

Based on traffic data generated for the Transportation Component of this report, the peak weekday PM traffic hour was selected for the one-hour analysis of both intersections. Peak eight-hour volumes for approaches at the two intersections were calculated by multiplying an eight-hour to one-hour factor by the peak one-hour traffic data. A peak eight-hour to one-hour factor of 0.72 was used, based on 24-hour traffic counts in the vicinity of the project.

Receptor locations were chosen to be consistent with recommendations in the EPA Guidelines, specifically:

- o Where maximum carbon monoxide concentrations are likely to occur (i.e., adjacent to intersection vehicle queues), and

- o Where the general public is likely to have access.

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* EPA, Guidelines for Air Quality Maintenance Planning and Analysis Volume 9, (Revised): Evaluating Indirect Sources, Second Printing, EPA-450/4-78-001, Research Triangle Park.

The intersection geometry and receptor locations at the two intersections analyzed are shown in Figures V-28 and V-29. Both intersections are signalized.

3.5 Results

Intersection Analysis

The intersection analysis predicted maximum one-hour and eight-hour CO concentrations at the sensitive receptors described in Section 3.4. The results of this analysis are summarized in Table V-2.

The Build and No-Build results for both 1-hour and 8-hour time periods show no difference of CO levels at receptor locations. The number of vehicles generated by the project has no appreciable effect on air quality at the intersections.

Parking Garage Analysis

CO impacts from the project's proposed parking facility were calculated at all receptors. Table V-3 summarizes these results. The maximum predicted impacts from the proposed parking facility are 0.20 ppm (1-hour) and 0.10 ppm (8-hours) at the receptor at the cafe on Boylston Place.

Cumulative Results

The cumulative results of the intersection analysis, parking garage impacts, and background levels at each receptor are presented in Table V-4. These values represent the highest concentrations that might exist during the simultaneous occurrence of worst case meteorology and peak traffic conditions. Typical pollution levels are expected to be lower than these worst case values. Worst case CO impacts at each intersection area as follows:

Boylston Street/Tremont Street

The air quality analysis, at this intersection, demonstrated no violation of the one-hour CO National Ambient Air Quality Standards for any case. The maximum one-hour impact of 24.0 ppm was predicted under the existing case at the Brighams Restaurant doorway receptor. This level is well below the 35 ppm air quality standard.

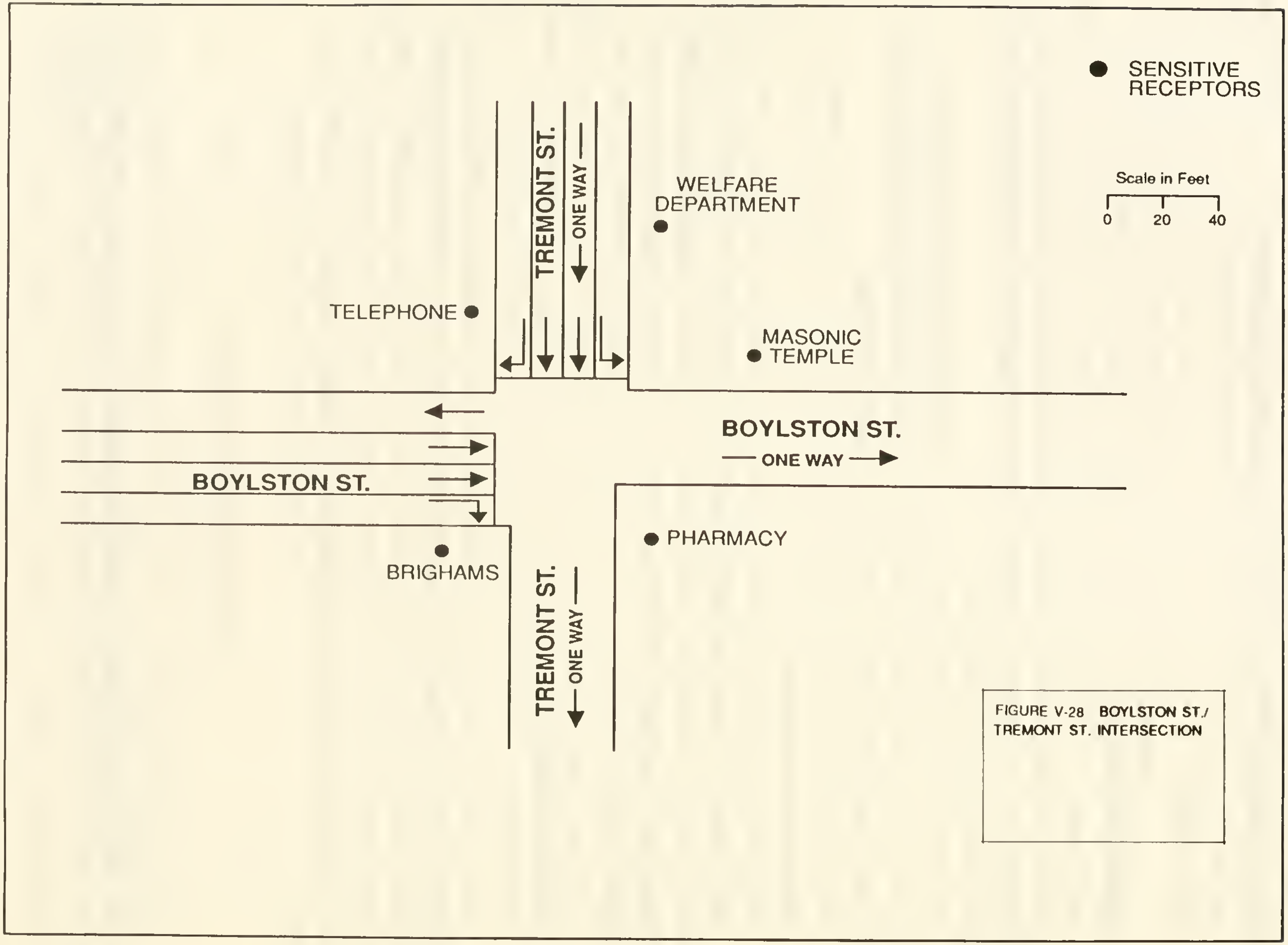


FIGURE V-28 BOYLSTON ST./ TREMONT ST. INTERSECTION

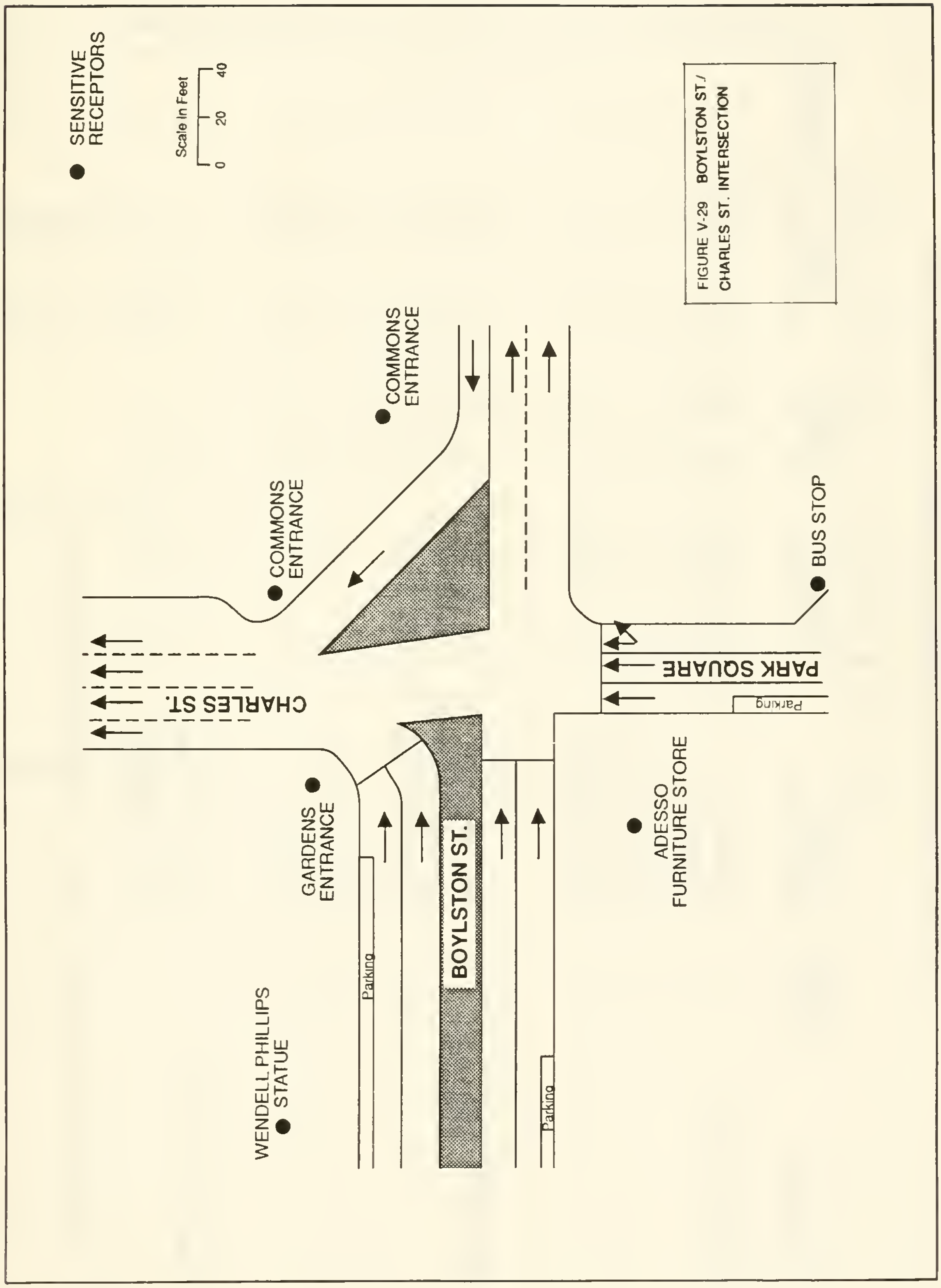


FIGURE V-29 BOYLSTON ST./ CHARLES ST. INTERSECTION

TABLE V-2

INTERSECTION ANALYSIS: MAXIMUM PREDICTED CO IMPACTS (PPM)*

Intersection	Receptor Number	Receptor Description	Existing 1-hr	Existing 8-hr	1990 No-Build 1-hr	1990 No-Build 8-hr	1990 Build 1-hr	1990 Build 8-hr	NAAQS 1-hr	NAAQS 8-hr
Boylston/Tremont	1	Brighams	24.0	12.5	20.8	10.6	20.8	10.6	35	9
	2	Telephones	18.6	10.1	16.4	8.8	16.4	8.8	35	9
	3	Pharmacy	17.8	8.3	15.8	7.5	15.8	7.5	35	9
	4	Welfare Department	19.4	10.2	16.9	8.8	16.9	8.8	35	9
	5	Masonic Temple	19.2	9.5	16.8	8.5	16.8	8.5	35	9
Boylston/Charles	1	Commons Entrance 1	13.3	6.3	11.9	5.9	11.9	5.9	35	9
	2	Commons Entrance 2	16.3	7.1	14.7	6.7	14.7	6.7	35	9
	3	Gardens Entrance	18.9	10.6	18.2	9.3	18.2	9.3	35	9
	4	Statue	15.0	7.1	15.1	6.7	15.1	6.7	35	9
	5	Furniture Store	18.6	9.9	16.5	8.7	16.5	8.7	35	9
	6	Bus Stop	17.1	11.1	19.0	9.6	19.0	9.6	35	9
Additional Receptors		Boston Place Cafe	8.3	4.2	8.0	4.1	8.0	4.1	35	9
		Project Front Door	14.2	6.4	13.1	5.8	13.1	5.8	35	9

* Background levels included: 5.0 ppm (1-hour) and 3.0 ppm (8-hour)

TABLE V-3

MAXIMUM PREDICTED CO IMPACTS (PPM) OF THE PROJECT'S PARKING FACILITY

Intersection	Receptor Number	Receptor Description	Proposed Underground Garage Impact 1-hr	8-hr
Boylston/Tremont	1	Brighams	0.044	0.022
	2	Telephones	0.039	0.019
	3	Pharmacy	0.038	0.019
	4	Welfare Department	0.031	0.015
	5	Masonic Temple	0.034	0.016
Boylston/Charles	1	Commons Entrance 1	0.092	0.045
	2	Commons Entrance 2	0.056	0.027
	3	Gardens Entrance	0.047	0.023
	4	Statue	0.036	0.018
	5	Furniture Store	0.055	0.027
	6	Bus Stop	0.095	0.046
Additional Receptors		Boston Place Cafe	0.20	0.10
		Project Front Door	0.12	0.06

TABLE V–4

CUMULATIVE MAXIMUM PREDICTED CO IMPACTS (PPM)

Intersection	Receptor Number	Receptor Description	Existing 1–hr	Existing 8–hr	1990 No–Build 1–hr	1990 No–Build 8–hr	1990 Build 1–hr	1990 Build 8–hr	NAAQS 1–hr	NAAQS 8–hr
Boylston/Tremont	1	Brighams	24.0	12.5	20.8	10.6	20.8	10.6	35	9
	2	Telephones	18.6	10.1	16.4	8.8	16.4	8.8	35	9
	3	Pharmacy	17.8	8.3	15.8	7.5	15.8	7.5	35	9
	4	Welfare Department	19.4	10.2	16.9	8.8	16.9	8.8	35	9
	5	Masonic Temple	19.2	9.5	16.8	8.5	16.8	8.5	35	9
Boylston/Charles	1	Commons Entrance 1	13.3	6.3	11.9	5.9	12.0	5.9	35	9
	2	Commons Entrance 2	16.3	7.1	14.7	6.7	14.8	6.7	35	9
	3	Gardens Entrance	18.9	10.6	18.2	9.3	18.2	9.3	35	9
	4	Statue	15.0	7.1	15.1	6.7	15.1	6.7	35	9
	5	Furniture Store	18.6	9.9	16.5	8.7	16.6	8.7	35	9
	6	Bus Stop	17.1	11.1	19.0	9.6	19.1	9.6	35	9
Additional Receptors		Boston Place Cafe	8.3	4.2	8.0	4.1	8.2	4.2	35	9
		Project Front Door	14.2	6.4	13.1	5.8	13.2	5.9	35	9

Under future cases, 1-hour levels decrease as a result of federal regulations requiring emission reductions of motor vehicles. The highest one-hour predicted level for these cases is 20.8 ppm also at the Brighams' receptor. The air quality analysis shows that the additional vehicles of the project at this intersection will have no effect on the CO levels in the area.

Eight-hour CO impacts will also not be affected by the project. The analysis, however, shows violations of NAAQS at four receptors in the existing case and one receptor in both Build and No-Build cases in 1990. The receptor at Brighams indicated the highest predicted level of 12.5 ppm under the existing case. This level is 3.5 ppm higher than the eight-hour standard. In 1990, this level decreases to 10.6 ppm, 1.6 ppm higher than the eight-hour standard.

Boylston Street/Charles Street

No one-hour exceedence of NAAQS was predicted for any case. The highest predicted one-hour CO level is 19.1 ppm, at a receptor located at a bus stop on Charles Street, under the Build case. This level is well below the one-hour standard of 35 ppm. At all other receptors modeled for this intersection, future Build and No-Build one-hour concentrations decreased from the existing case. The analysis demonstrates that the project's additional vehicles at this intersection will have minimal impact (increases of 0.1 ppm at four receptor locations) when compared to the No-Build case.

Under the eight-hour case, the project also has minimal impact. Under the existing case the highest CO concentration is 11.1 ppm at the Charles Street bus stop receptor. This level is 2.1 ppm above eight-hour NAAQS. Two other locations (Public Gardens Entrance and the Adesso Furniture Store) are also above the eight-hour standard in the existing case. At those locations, CO levels of 10.6 ppm and 9.9 ppm, respectively, were predicted. Under both the future No-Build and Build cases, these levels decreased, although exceedences of the eight-hour standard are still noted at the Public Gardens entrance (9.3 ppm) and the Charles Street bus stop (9.6 ppm). These levels, however, represent improvements of 1.3 and 1.5 ppm, respectively.

Additional Receptors

No exceedences of the NAAQS are predicted in any case for the two receptors located at the Boylston Place cafe and the proposed building's entrance. The highest predicted one-hour CO level is 14.2 ppm at the front door of the project under the

existing case. This level is well below the one-hour standard. The highest predicted eight-hour CO level is 6.4 ppm in the existing case at the same receptor location, also below the eight-hour standard of 9 ppm.

3.6 Mitigation Measures

The Commonwealth's I&M program started on April 1, 1983 and has been assumed in the calculation of motor vehicle emission rates. This program, which results in the overall reduction of yearly motor vehicle emissions, was established to ensure compliance with the NAAQS on a statewide basis, as outlined in the Massachusetts State Implementation Plan. The attainment and maintenance of the NAAQS for CO in the future is dependent on the continued enforcement of this program.

Other traffic-related mitigation measures to reduce vehicle conflicts and delays could similarly improve existing and future air quality. In general, such traffic-related measures include roadway geometry changes which increase roadway capacities, and signal timing optimization which enhances traffic flow.

Currently, the City of Boston is in the process of optimizing, through computer operated traffic flow monitors, approximately 250 signals downtown, including the project study area. Completion of this program is expected in 1990. Computer driven signal timings, which will be based on demand, will improve traffic flow over peak one- and eight-hour periods in the project area. During eight-hour periods, when the only violations of the NAAQS for CO were predicted, continual monitoring of traffic conditions and appropriate adjustments to signal timings under this program will provide significant potential air quality benefits. In addition, this program will serve to reduce CO background levels as general flow in the downtown area will improve.

3.7 Construction Related Impacts

Project related air quality impacts are anticipated to be limited to emissions of fugitive dust during the construction period. Impacts associated with land clearing, ground excavation, cut-and-fill operations and other construction activities may generate fugitive dust, which will result in localized increases in airborne particulate levels. Fugitive dust emissions from construction activities will depend on such factors as the properties of the emitting surfaces (e.g. soil silt content, moisture content, and volume of spoils), meteorological variables, and construction practices employed.

To reduce emissions of fugitive dust and minimize impacts on the local environment, a number of strictly enforced mitigation measures will be adhered to. These include:

- Use of covered trucks.
- Minimizing storage of spoils on the construction site.
- Locating aggregate storage piles away from areas having the greatest pedestrian activity.
- Monitoring of actual construction practices to ensure that unnecessary transfers and mechanical disturbances of loose materials are minimized.

4.0 Geotechnical Impacts

4.1 Existing Conditions

Interbedded clay and silty sand strata underlie the project site to a depth of 80 to 100 feet. Very dense glacial till underlies the clay and silty sand. The existing buildings adjacent to the site are supported by spread (column) footings and exterior wall footings. There are no soft or compressible soil formations below the project site to initiate a foundation settlement or a stability problem associated with the proposed building.

4.2 Proposed Project

The proposed building has a two-level below grade parking garage (only one-level below grade on the Carver Street side due to sloping ground). The building foundation will consist of spread footings supporting columns and load-bearing walls, and an earth supported slab-on-grade. The footings will bear on natural, competent, very stiff clay and/or dense silty sand stratum.

Construction of the foundation for the proposed 144-150 Boylston Street project will require approximately 20-foot and 10-foot deep excavations along Boylston Street and Carver Street, respectively. Groundwater levels at the project site, as observed through observation wells, are below the bottom of the proposed foundation excavation. Foundation excavation will involve removal of the clean miscellaneous fill soils blanketing the mid-portion of the project site and will have no negative environmental impact. Since the groundwater level is below the bottom of the foundation excavation, no construction dewatering is anticipated. That is, both during construction and the subsequent service life of the building, groundwater levels will not be affected by the building foundation. There will be no discharge to the groundwater from the building.

Foundations of the existing structures adjacent to the project site will be secured prior to proposed foundation excavation. Similarly, sidewalks along Boylston Street and Carver Street will be protected against settlements and lateral movements by braced temporary lateral support systems. If tiebacks are used along Boylston Street, they will be designed and installed such that there will be no interference with the Boylston Street tunnel as well as existing underground utilities. The excavation support system along Boylston Street will consist of steel soldier piles and wood lagging braced either by

tiebacks or rakers. Along Carver Street, the soldier pile and lagging will not require bracing. The existing adjacent buildings are supported on spread (column) footings and exterior wall footings. The existing wall footings along the two sides of the site will be under-pinned to maintain the structural integrity of these buildings during the foundation construction.

5.0 Noise

Since the proposed 144-150 Boylston Street project is primarily a residential development, residents of the condominiums will be sensitive to noise. An evaluation of ambient noise levels was performed to determine whether the project will be within the noise level criteria established by the U.S. Department of Housing and Urban Development (HUD) for residential developments. The purpose of the HUD guidelines is to encourage a pattern of comfortable coexistence between housing and other noise sensitive land uses, and major urban noise sources. The guidelines also provide policy on the use of noise attenuation measures, where needed. The HUD noise level criteria are listed in Table V-5. Although the 144-150 Boylston Street project is not a HUD project, the residential noise level criteria listed in their regulations are used as a guideline in evaluating whether a site is appropriate for residential development.

TABLE V-5

HUD SITE ACCEPTABILITY STANDARDS

	Day-Night Average Sound Level L_{dn} (in decibels)
Normally Acceptable	Not exceeding 65 dB*
Normally Unacceptable	Above 65 dB but not exceeding 75 dB
Unacceptable	Above 75 dB

* Normally acceptable threshold may be shifted to 70 dB in special circumstances.

In order to evaluate the ambient noise levels in the project area, a brief monitoring program was conducted at the site along Boylston Street. Noise measurements were conducted at 10-minute intervals at various times of the day and night. Each level measured was considered representative of ambient noise during a particular hour or group of hours during a 24-hour period.

The noise measurement data indicates that the average day-night sound level (L_{dn}) in the project area is about 67-68 dBA. This is slightly higher than the HUD criteria of 65 dBA. However, the level considered to be normally acceptable may be increased to 70 dB, under special circumstances. The 144-150 Boylston Street project may fall within this HUD exception, since the project meets:

1) Goals of providing housing in proximity to employment, public facilities, and transportation;

2) The project is in conformance with local goals and maintains the character of the neighborhood; and

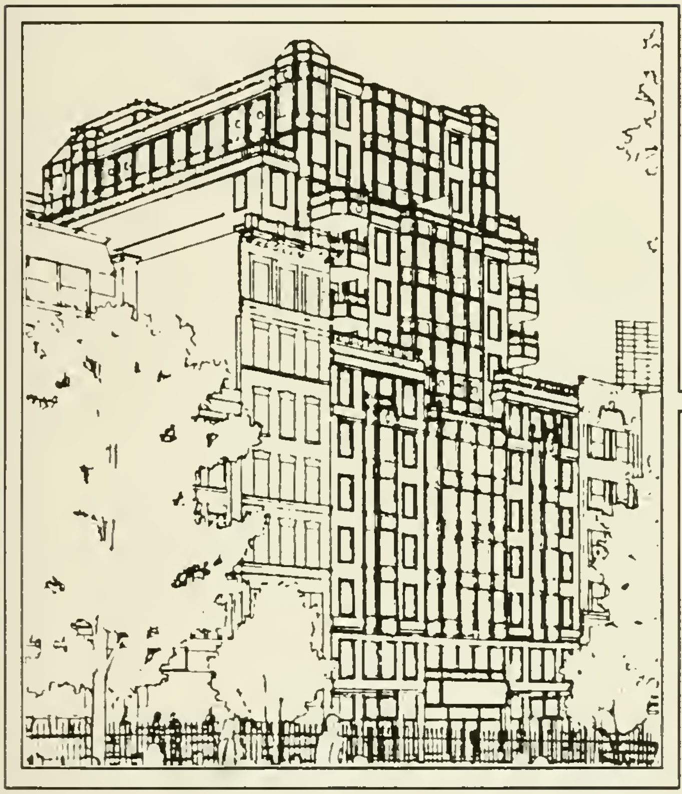
3) Other sites which have an L_{dn} of 65 dB or less are generally not available in the City.

The project area and much of the inner city areas experience fairly high noise levels typical of an urban environment. The project area in particular is a fairly lively environment, both during the day and evening hours. However, these same characteristics also make the project's location attractive as a residential development. Nonetheless, the 144-150 Boylston Street proponent will incorporate into the building's design noise attenuation measures. This will include installing double-glazed windows and appropriate amounts of insulation in the walls to reduce the noise levels experienced by future residents of the proposed development.

6.0 Rodent Control

The City of Boston has determined that the infestation of rodents in the city is a serious problem to be contended with. In order to control this infestation, the City has established requirements under the Massachusetts State Sanitary Code, Chapter II, 105 CMR 410.550 and the State Building Code, Section 108.6. Policy Number 87-4 establishes that extermination of rodents shall be required for issuance of permits for demolition, excavation, foundation, and basement rehabilitation.

The project proponent will have contracted with a licensed exterminator prior to beginning any work on the project. A rodent extermination certificate will be filed with the building permit application to the City. Rodent inspection, monitoring, and treatment will be carried out before, during, and at the completion of all foundation work for the proposed project, in compliance with the City's requirements. Rodent extermination prior to work start-up will consist of treatment of the entire project area, including all alleyways, surrounding building exteriors, and building interiors. This treatment will consist of two service visits. During the construction process, bi-monthly service visits will be made in order to maintain effective rodent control levels.



VI. URBAN DESIGN COMPONENT

VI. URBAN DESIGN COMPONENT

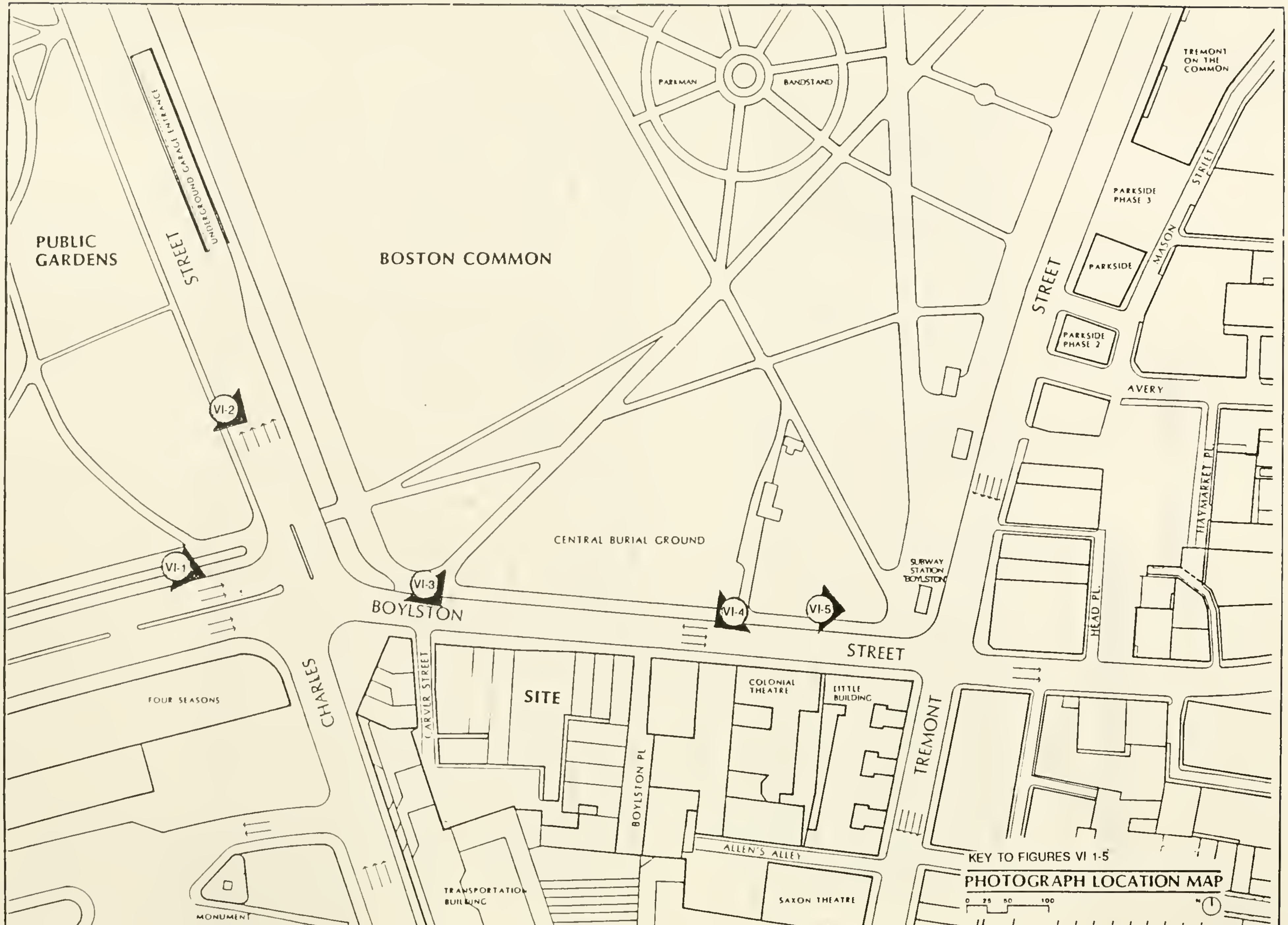
1.0 Summary of Proposed Development

1.1 Location

The proposed project is to be built on lots 144-150 Boylston Street on the south side of the Boston Common. This portion of Boylston Street is located within the Piano Row subdistrict of the Theater Multiple Resource Area which is listed in the National Register of Historic Places. The site also lies within the City of Boston's proposed Midtown Cultural District. The State Department of Transportation Building is located to the rear (south) of the site. Boylston Place, a pedestrian way connecting the Common to the Department of Transportation Atrium, is located approximately 80 feet to the east of the site. Vehicular access to the site is gained from Boylston Street to Carver Street and an open paved area which also serves the Department of Transportation Building.

1.2 Existing Conditions

The architectural character of the existing nearby structures may be established by reference to the accompanying photographs and locator key, Figures VI-1 through VI-5. Boylston Street itself has a distinctly inconsistent character along the two blocks bordering the Common. To the east one finds imposing buildings of dressed stone with elaborately carved cornices, belt courses, and window surrounds, in both the Gothic and Classical idioms. To the west the structures are considerably smaller, more often than not located on 25-foot wide lots, and, with the exception of the delicately figured spandrels and frieze on the Steinert building at the far western end, they are more simply rendered, the use of stone confined for the most part to lintels and sills. The street is also notable for a few fine, and in the case of the Wurlitzer store, flamboyant storefronts, characteristic of many storefronts in the midtown dating from the early 1900s, and for two handsome interior spaces "bookending" the street, the Colonial Theatre and Steinert Hall, both built at the turn of the century. On the site itself two small buildings will be demolished. One was recently gutted by fire and is vacant; the other, the smallest on the block, is a small brick rowhouse now disfigured by unfortunate window and storefront retrofits.



KEY TO FIGURES VI 1-5

PHOTOGRAPH LOCATION MAP

FIGURE VI-1 VIEW FROM PUBLIC GARDEN

FIGURE VI-2 VIEW FROM CHARLES ST.

FIGURE VI-3 VIEW FROM ACROSS CARVER ST.

FIGURE VI-4 VIEW FROM SATCHMO WAY

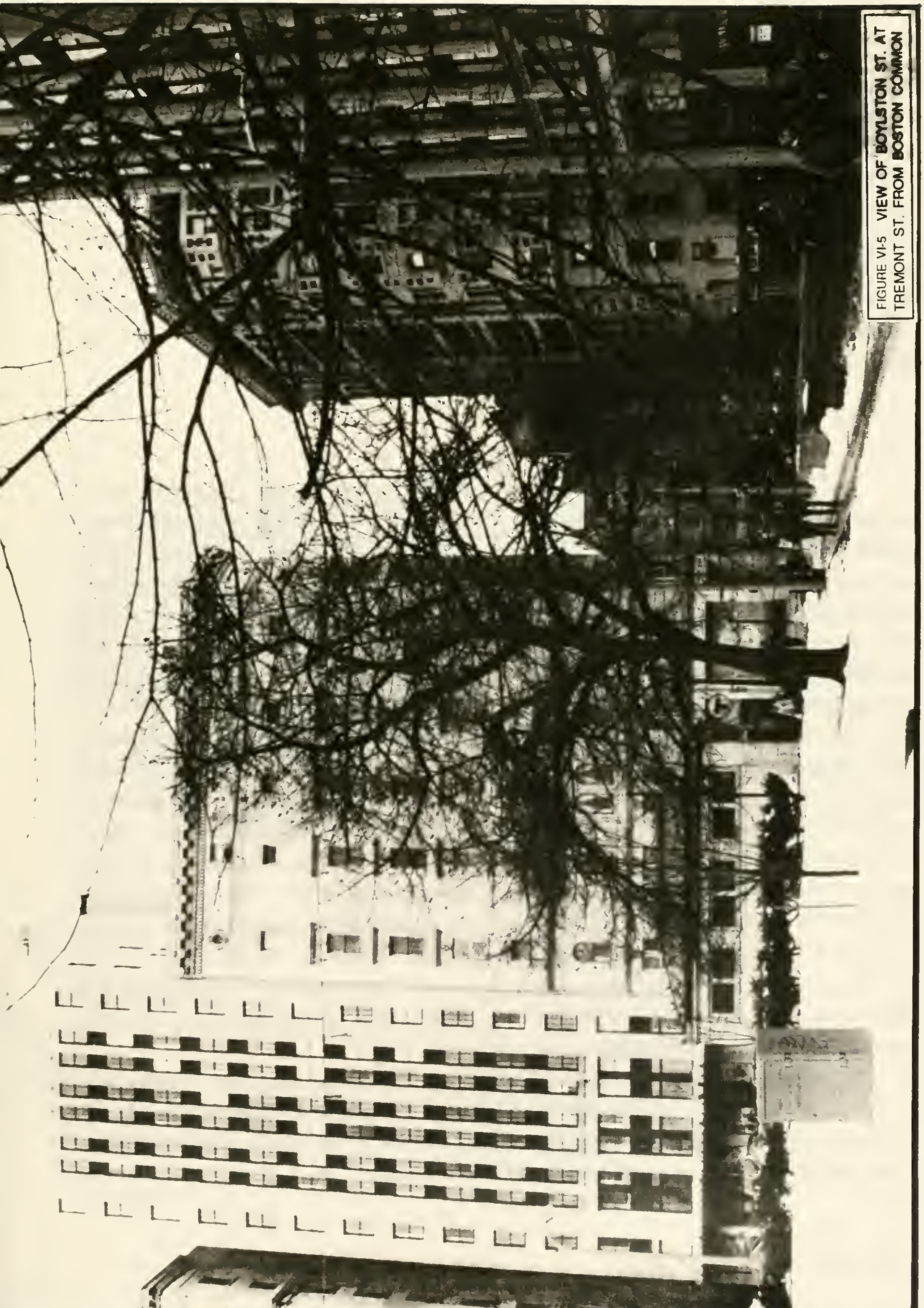


FIGURE VI-5 **VIEW OF BOYLSTON ST. AT TREMONT ST. FROM BOSTON COMMON**

The majority of nearby buildings contain office space on the upper floors and retail concerns on the street level. Recent developments on the edge of the Common and Public Garden in the general area of the proposed project have been primarily residential in nature, again with ground floor retail uses. Major examples are the Heritage and Four Seasons, both facing the Public Garden, and the Parkside towers, the first of which is under construction on the eastern side of the Common. The Colonial Theatre and the Boylston Place walkway are the closest neighborhood features directly related to the cultural life of the city, and are important elements of what Douglass Shand Tucci has referred to as Boston's Rialto.

1.3 Proposed New Construction

The proposed project will contain residential condominium units, commercial space and parking. The dwelling units constitute the principal use of the building and occupy floors 3-13. There will be 37-41 units, depending on whether or not an option to duplex certain units is elected. The ground floor will be devoted to active, street oriented uses such as retail stores, and the second floor will contain either an extension of the ground floor use or leased office space. Two full levels below the Boylston Street grade and portions of three other levels (floors 3, 4 & 5) at the rear of the site are proposed for parking to be accessed by a valet operated car lift.

The building will be 125 feet high measured from Boylston Street with major setbacks at the seventh and eleventh levels and various balconies and roof decks at other locations to modulate the scale of the facades and provide amenity to the occupants of the building. The portions of the project visible above adjacent existing buildings will be massed in three distinct volumes, a residential volume in the front of the site and one in the rear linked by a circulation core, to preclude any slab effect. Principal materials proposed for the facades are brick and cast stone, representing a blending of the material palettes of the buildings to either side of the project. In general, flat wall surfaces will be brick with the cast stone used for window trim, belt coursing, bay window frames and elaboration of the base and top of the building. Figures VI-6 through VI-8 show elevation drawings for the proposed building.

By consulting the north elevation (Figure VI-6) one can see that every window will be framed with a cast stone surround. The intent is that these surrounds will be detailed with a bevelled profile and when grouped together will be articulated by reveal joints and corner moldings. Like the original ground level elements of the Colonial and the Little

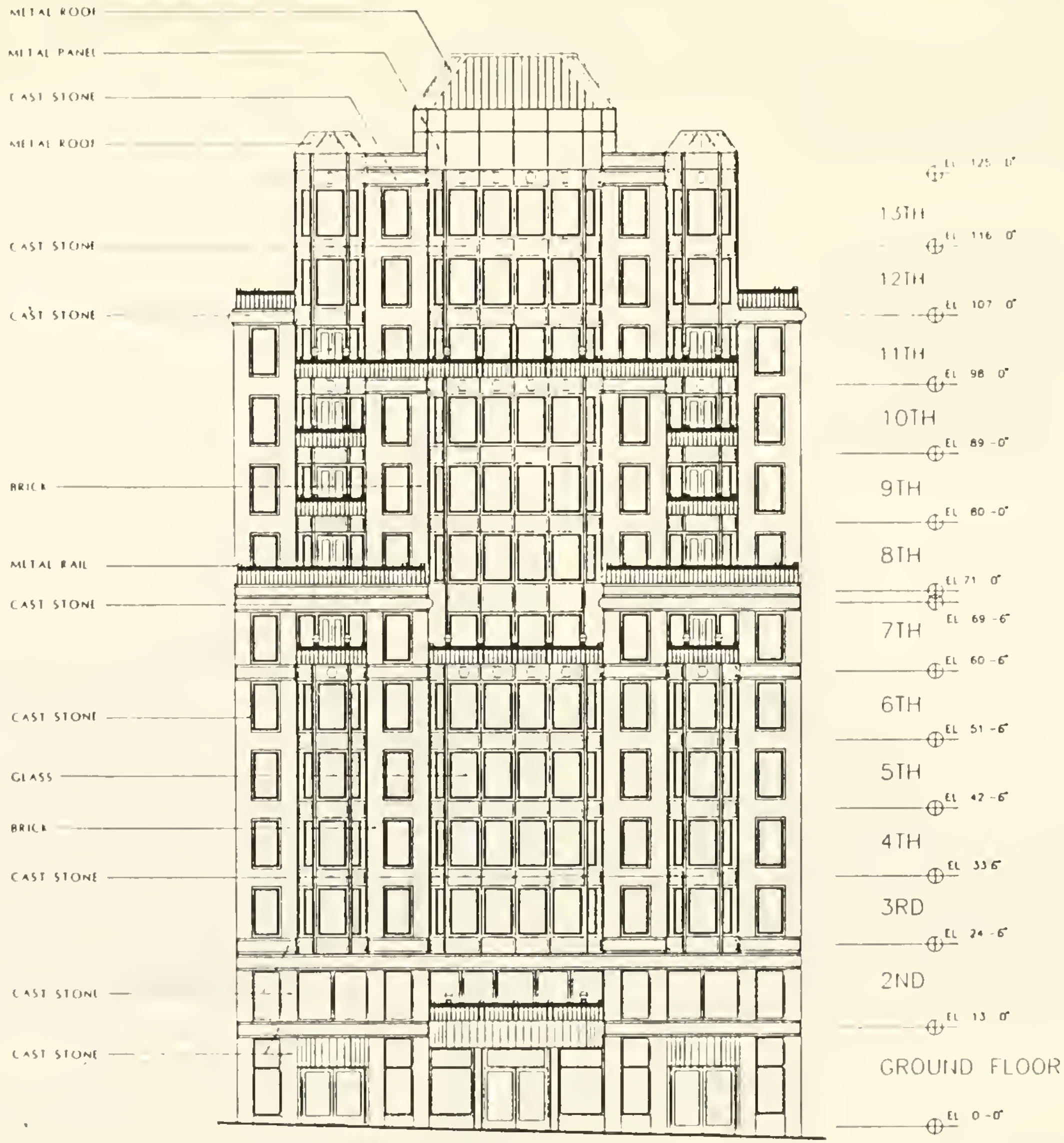


FIGURE VI-6

NORTH ELEVATION

0 4 8 16

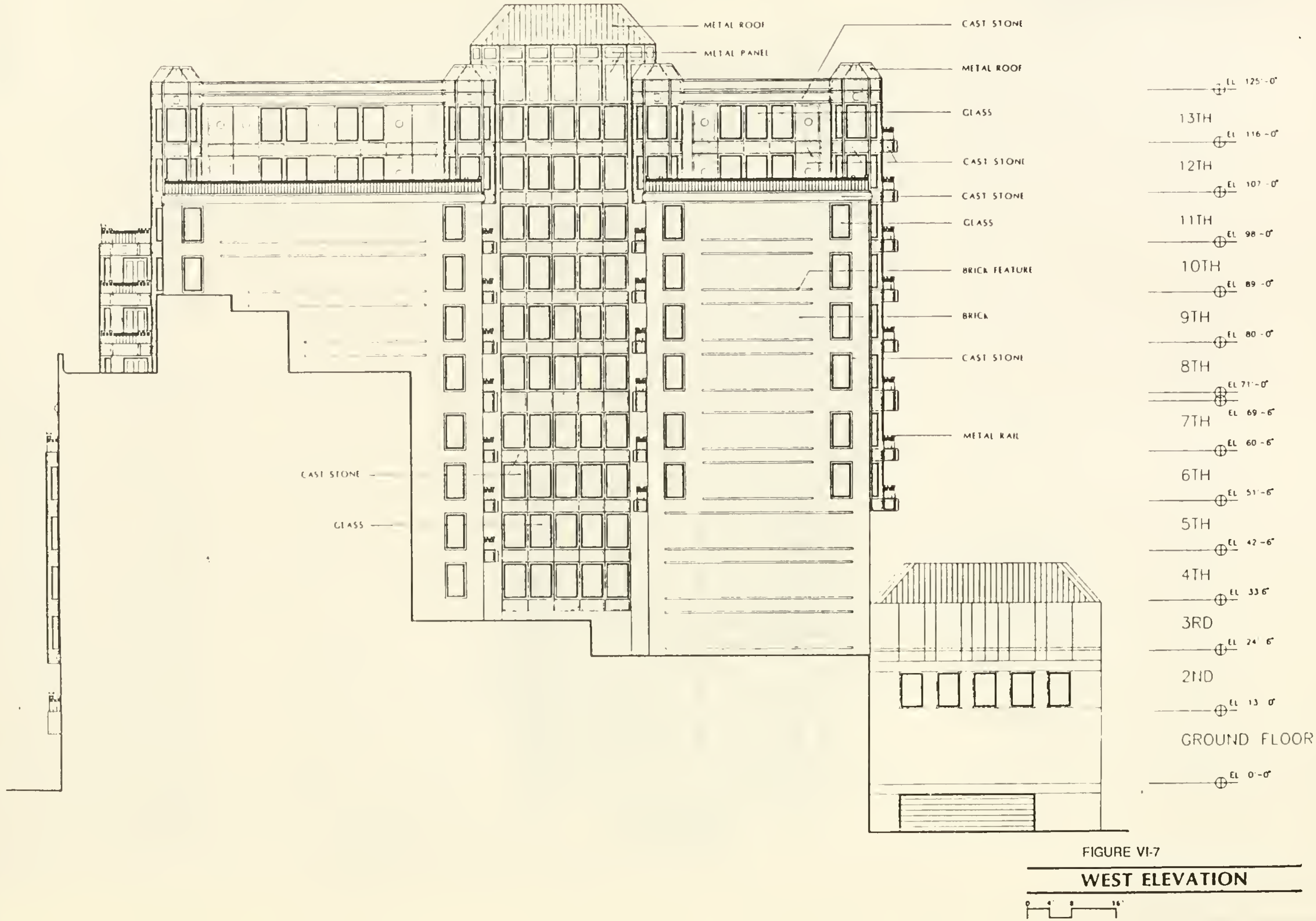


FIGURE VI-7

WEST ELEVATION

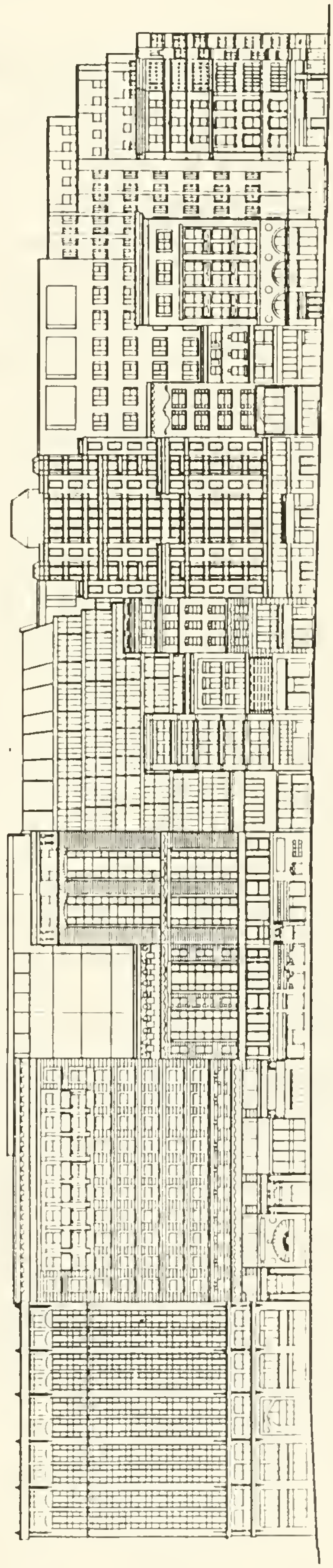


FIGURE VI-8

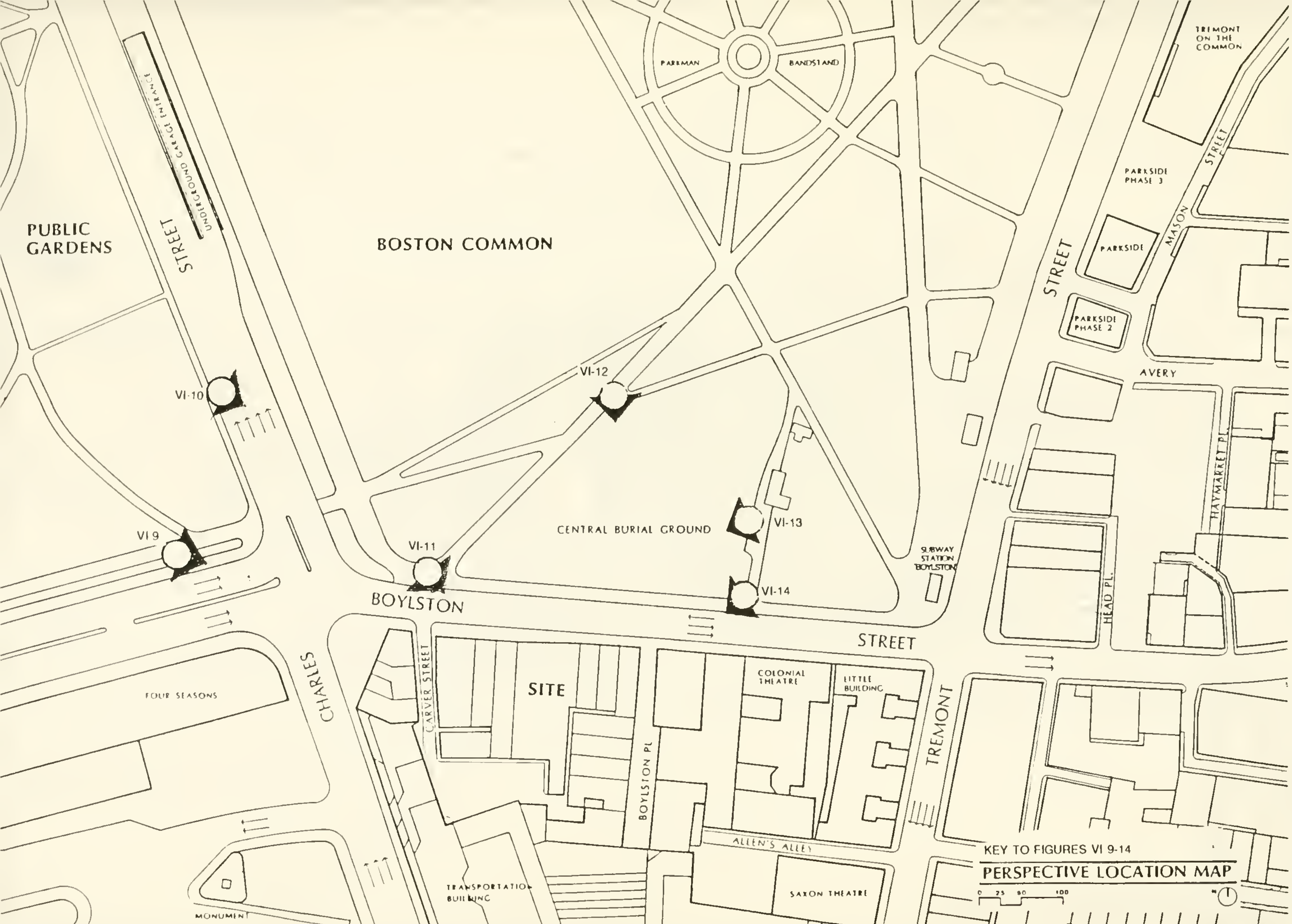
BOYLSTON STREET ELEVATION

0 12 24 48

Building, the storefront and entries will be interwoven with piers carrying the rhythm of the upper facade down to the street. The actual detailing of the storefront and entries will be carried out with a standard of care and with the aim of achieving a dignity compatible with the best examples presently on the street.

Figures VI-9 through VI-14 illustrate the proposed project in the neighborhood context in elevation and from various viewpoints. It should be noted that the project cannot be seen for the most part from locations in Park Square because of the intervening bulk of the Department of Transportation Building. The perspective drawings illustrate the project's relatively unassuming presence on the street and skyline when compared with structures such as the Colonial Theatre and Little Building which have taller parapets and no setbacks. At the same time it can be seen in these drawings and by consulting the ground floor plan (Figure I-9) that the "street wall" of the immediate context is maintained by the slight angling in plan of the facade of the lower seven floors. The low mass constituting these floors hugs the street line and features an extensively glazed display wall area at the base in conformance with the intent of the zoning proposed for the midtown to ensure a lively pedestrian environment. While the massing concept restores street continuity it also reflects the lot by lot variety found in the immediate block by establishing a three bay rhythm across the width of the building through the medium of bay windows and a recess at the top of the middle bay.

The project development team is confident that the building will meet the combined objectives of the proponents of the neighborhood's cultural vitality and historic continuity. While a specific cultural use is not proposed for the site, the planned use, housing, is directly encouraged by the proposed midtown plan. The residents of the building will bring animation to the street at all hours, and can be expected to patronize the cultural activities in the district. In all built respects, the project meets the intent of the zoning as to setbacks, street wall, cornice alignments and storefront treatment. The facade treatment, while generously fenestrated for the benefit of the occupants, is rendered in a masonry idiom of punched windows, belt courses and strong cornices in keeping with the rest of the block. The bay windows, also a common element up and down the street, are a particularly appropriate device to incorporate into the proposed project, given their association with residential architecture. Great effort has been expended to open up as much of the street level as possible to retail use by moving the principal lobby for the residences and the small lobby for the second floor commercial space deep into the middle of the building, connecting to the street by a corridor and small vestibule at the west side of the ground floor.



KEY TO FIGURES VI 9-14

PERSPECTIVE LOCATION MAP

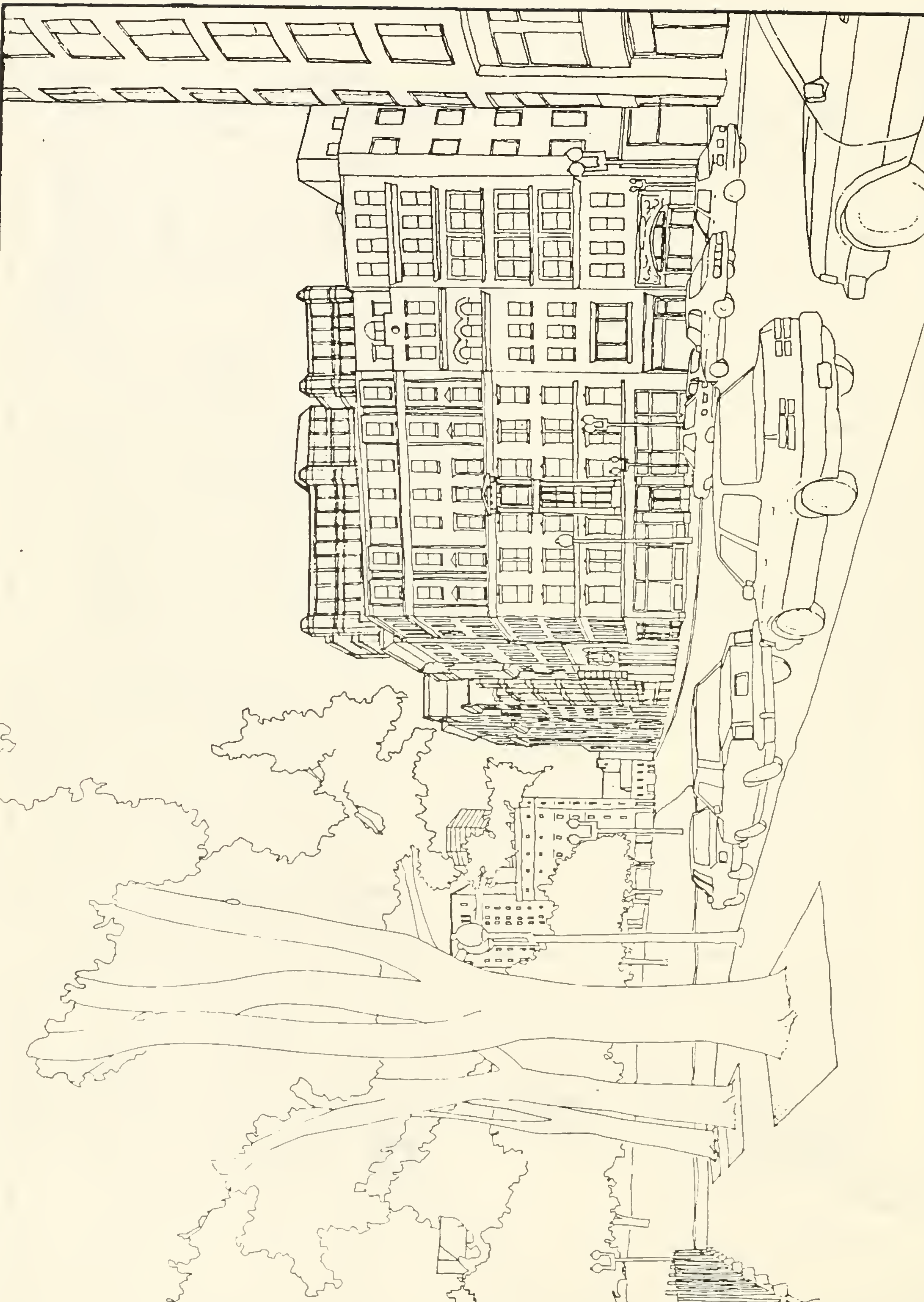


FIGURE VI-9 PERSPECTIVE FROM PUBLIC GARDEN

FIGURE VI-10 PERSPECTIVE FROM CHARLES ST.

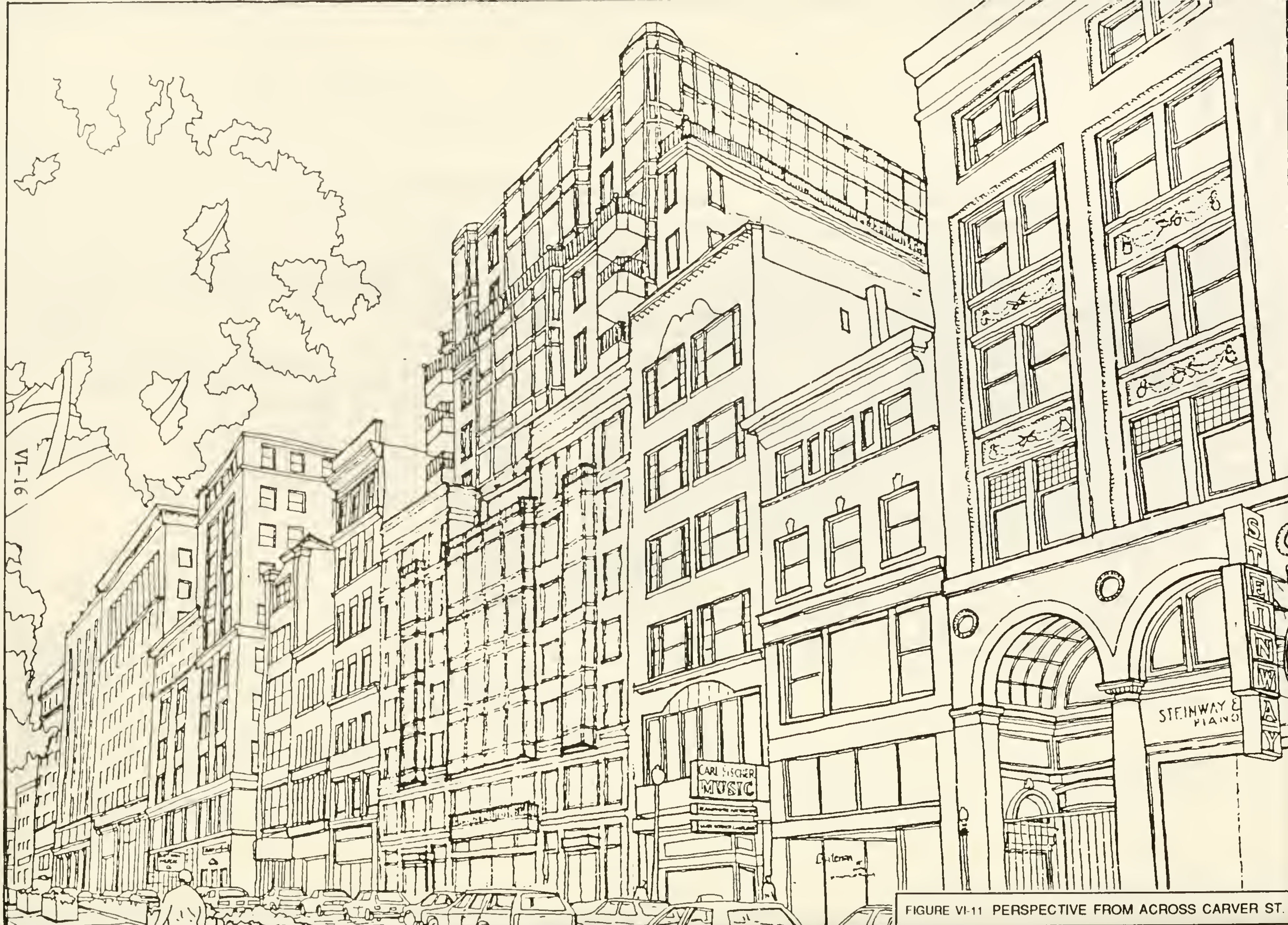


FIGURE VI-11 PERSPECTIVE FROM ACROSS CARVER ST.

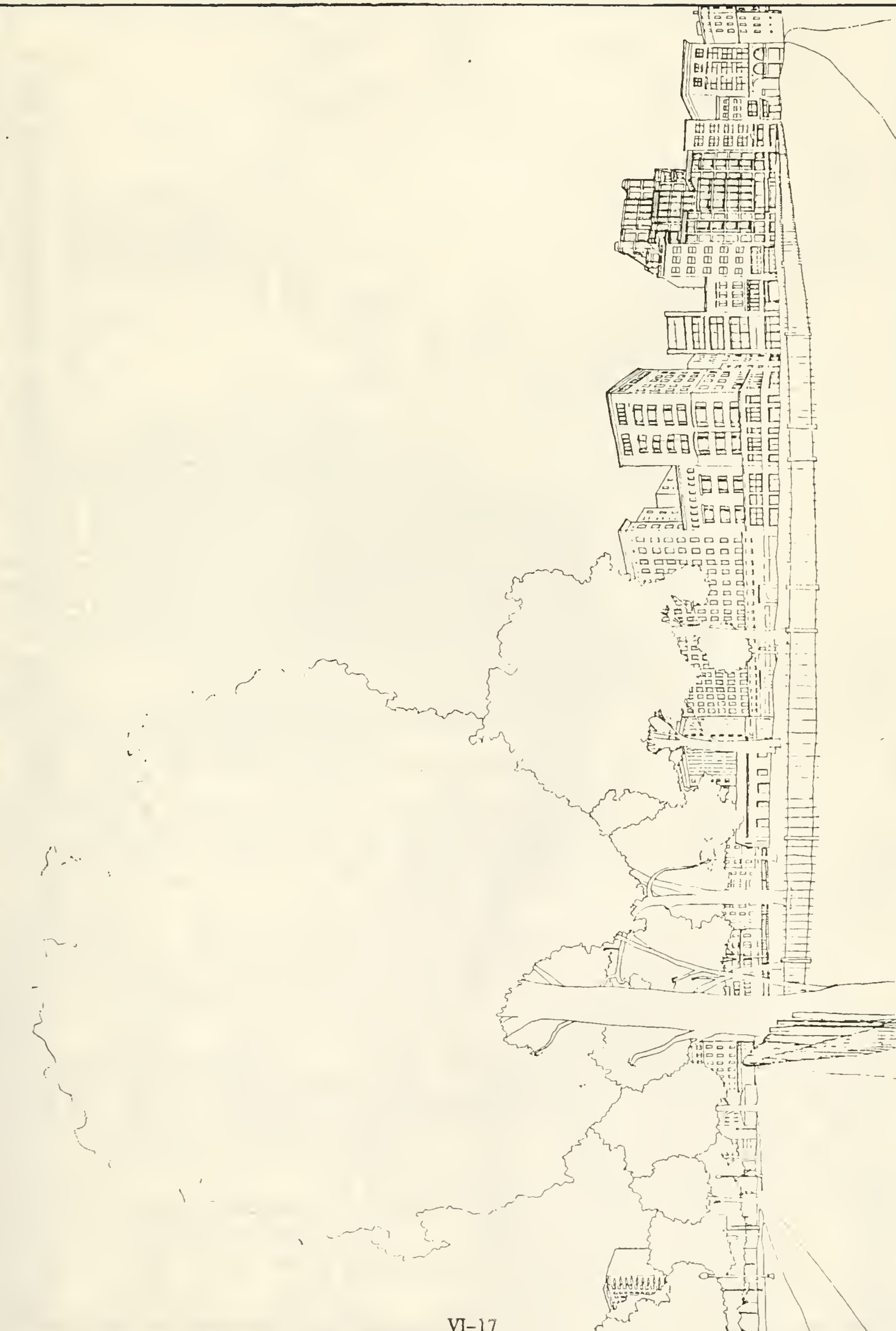


FIGURE VI-12 PERSPECTIVE FROM BOSTON COMMON

FIGURE VI-13 PERSPECTIVE FROM CENTRAL BURIALGROUND

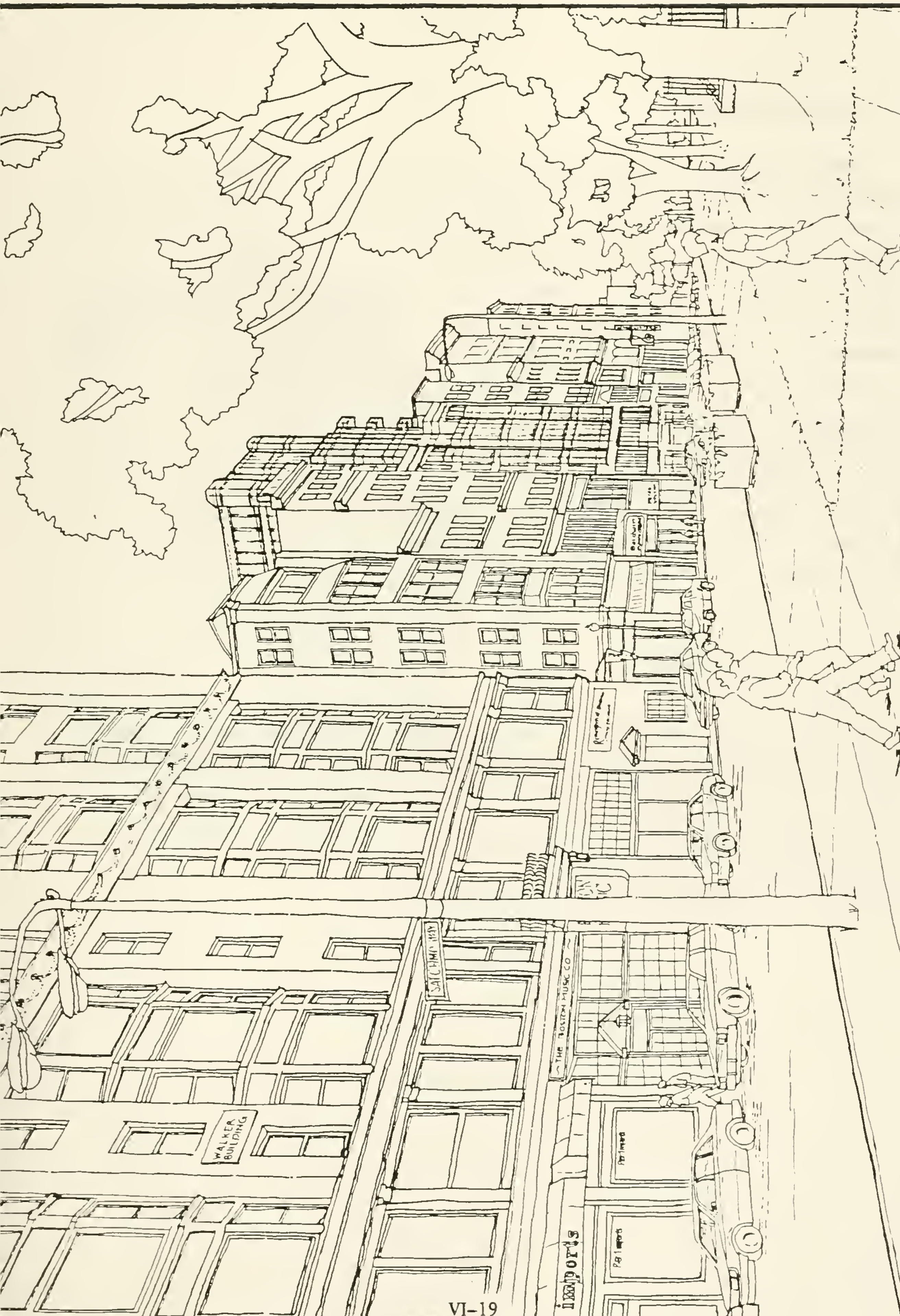


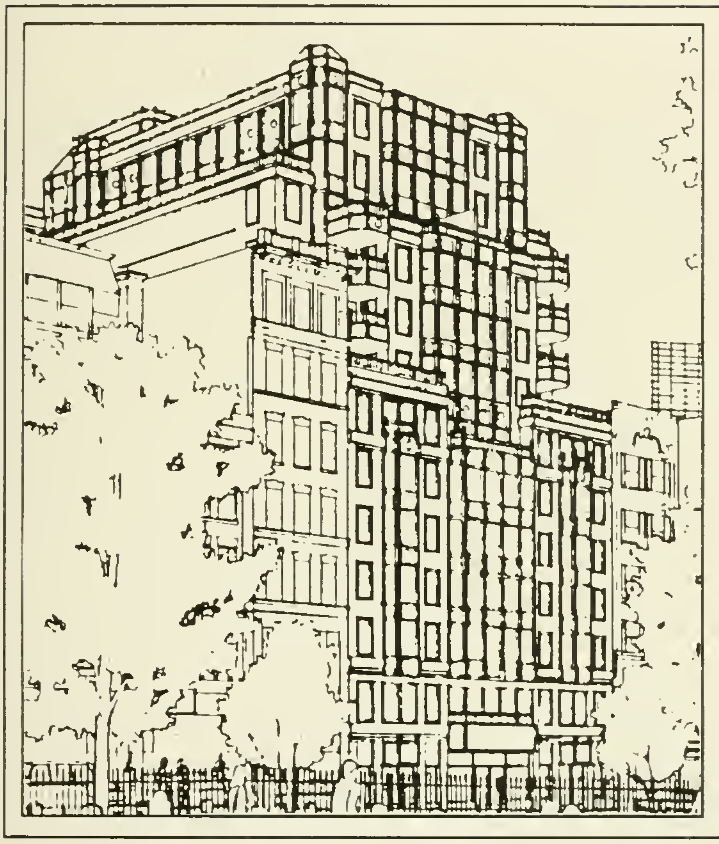
FIGURE VI-14 PERSPECTIVE FROM SATCHMO WAY

2.0 History of Reviews

Since September of 1987 the developers of the project have engaged in productive discussions with the BRA aimed at establishing massing and material selection guidelines for the building which will ensure a harmonious fit with neighboring structures. Several variations of height and massing have been discussed within the context of the evolving zoning requirements for the area. Working with the provisions of the underlying Boston Zoning Code, the Interim Planning Overlay District, and the intent of the proposed Midtown Cultural District Plan, the developers have proposed building masses at 155 feet and 135 feet with variations on each, and the 125-foot design described in this document. With each adjustment in height, corresponding adjustments in number and extent of setbacks have been presented and reviewed. There appears to be substantial agreement that the current massing represents a good balance between limiting the assertiveness of the building within its context, allowing full utilization of the site for housing, a use encouraged by the zoning documents, and creating a mass, which while articulated at various levels by setbacks, results in a unified building.

3.0 Development Schedule

The developers of the project intend to continue to cooperate with the BRA and concerned citizen groups to bring about a design embodying the balanced aspirations of all interested parties for the site. At the completion of this process the developers will approach the BRA Board for a favorable vote and the Zoning Board of Appeals for any necessary relief. A 16-month construction period is anticipated with phased occupancy to commence approximately 14 months after groundbreaking.



VII. HISTORIC RESOURCES COMPONENT

1.0 History of the Project Area

Located within the Piano Row Historic District and across from the Boston Common, the 144-150 Boylston Street site is in an area of much historical significance. The Piano Row District is within the larger Boston Theater Multiple Resource Area (MRA). The Theater MRA was surveyed by the Boston Landmarks Commission during 1978 and 1979. The Theater MRA, a subdivision of the Central Business District, is a predominantly commercial area. The area achieved its significance primarily as an entertainment district and also as the fashionable location for piano showrooms and music businesses which occuped Piano Row along the Boston Common. It is presently the subject of revitalization programs aimed at reversing the deterioration of recent decades, which has led to a high building vacancy rate, deferred maintenance, and a large number of vacant lots.

The Piano Row District includes 29 commercial buildings of the late 19th century and early 20th century. The buildings along Piano Row are of high architectural quality and include fine examples of major firms such as Winslow and Wetherell, and Blackall, Clapp and Wittemore. The area achieved its greatest significance during the periods between 1890 and 1930, when it included a number of piano dealers and other music-related industries, major hotels, institutions, and theaters. The most significant buildings constructed for music companies were the Steinert Building of 1896 and the Oliver Ditson Building of 1917. Even the building on the project site at 144 Boylston Street housed one or more music dealers during that turn of the century period.

The Boston Common and Public Garden includes 74 acres of open space in the heart of the city. The Boston Common was established in 1634 and at that time was at the edge of town. At that time, the area where the Public Garden was created about two centuries later, was tidal marshland. Within the Boston Common and immediately across from the project site is the Central Burial Ground, established in 1756. The Boston Common is considered the oldest public park in the country. It was set aside as common land for the citizens, as pasturage for cattle, and as a military training field. The Central Burial Ground is the resting place for soldiers who died at the Battle of Bunker Hill and during the British occupation.

Much of the significance of the Boston Common and Public Garden lies in the amount and quality of the sculpture that adorns them. Beacon Hill, Back Bay, the State House, the Park Street and Arlington Street Churches, St. Paul's Cathedral, all face the Common and Garden and contribute to the quality of this historic environment.

2.0 Ratings of Existing Buildings

There are presently two buildings on the project site. The 144 Boylston Street building was constructed between 1815 and 1820 and represents one of the older buildings in the Piano Row District. It is a 3-1/2 story brick Federal rowhouse which has been altered on the first two floors. The building at 150 Boylston Street was built from 1883 to 1890 as a 4-story brick Queen Anne commercial building. The building survey which the Boston Landmarks Commission conducted, resulted in these buildings being classified as Category IV (144 Boylston Street) and Category V (150 Boylston Street), in terms of their historic significance.

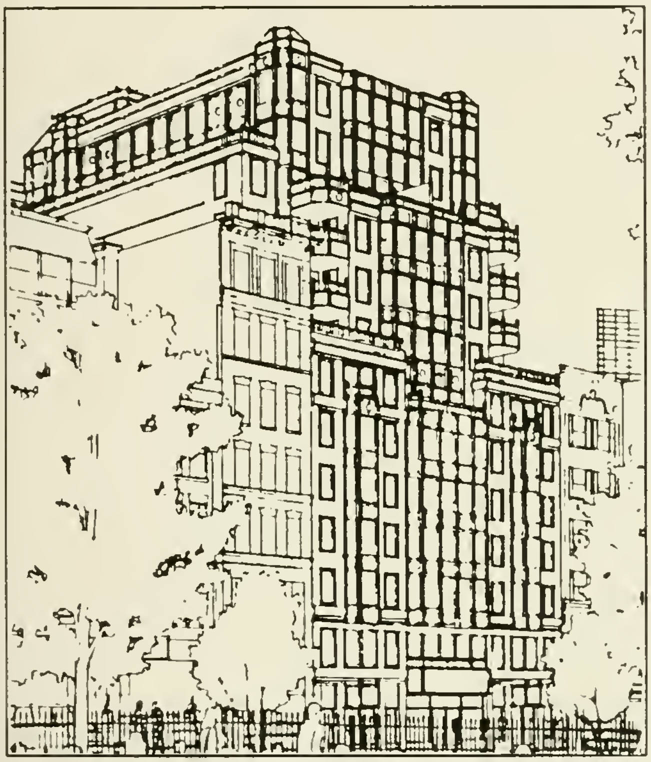
The Boston Landmarks Commission rating system defines a building in Category IV (Notable) as being important to the character of the particular street, neighborhood, or area. Buildings in Category IV are not considered significant enough to be designated as Boston landmarks or to be listed in the National Register of Historical Places. Category V (Minor) buildings are considered to be of little architectural or historical interest, but may be considered to make a minor contribution to the streetscape. Buildings in this category are not eligible as landmarks or for individual listing in the National Register.

3.0 Project Impacts

The two buildings on the project site will need to be demolished to make way for the proposed development. The Boston Landmarks Commission staff has stated that the Commission does not anticipate any problems with the demolition of the two structures. The Commission did stress, however, the importance of maintaining a height on the site that is similar to that of the Transportation Building and the Colonial Theater, both being about 138 feet high. The design presented in this report includes a proposed mass of 125 feet in height, which has evolved from several meetings with the BRA.

The particular design of the building intends to respect the varying styles found along the block. The building's mass has been broken up by incorporating various setbacks in height, and materials to be used (brick and cast stone) represent a blending of the materials on either side of the project.

In summary, the proposed development will have a positive impact on the area by revitalizing a deteriorated site and restoring the streetwall effect which at one time existed along that block of Boylston Street.



VIII. INFRASTRUCTURE SYSTEMS COMPONENT

VIII. INFRASTRUCTURE SYSTEMS COMPONENT

1.0 Introduction

This section reviews and analyzes the infrastructure service needs of the proposed 144-150 Boylston Street development. A determination of the impact of the development on the existing infrastructure systems is also presented. This evaluation includes a description of existing infrastructure facilities, current facility capacities, and a determination of their ability to accommodate the increased demands associated with the project. To support this analysis, estimates were prepared for water use, wastewater generation, space heating, air conditioning, lighting, and other general energy needs. Applicable permitting requirements and mitigation measures to be employed are also discussed.

2.0 Sewer and Water Service

2.1 Sewers and Drains

Description of Existing Facilities

A sanitary sewer is located in Carver Street and a 15-inch combined sewer is located along Boylston Street (Figure VIII-1) in the vicinity of the proposed development. Sanitary wastewater can be discharged to the sewer system by connection to either the sanitary or combined sewers. Storm water also can be managed by discharge to either the 15-inch combined sewer located in Boylston Street or the Carver Street sanitary sewer. These sewers and the associated interconnecting system which will convey all wastewater and drainage to the Deer Island Treatment Facility are owned and operated by the Boston Water and Sewer Commission (BWSC) (Figure VIII-2).

Sanitary wastewater and storm water routed through Manhole 75 under normal conditions follow a flow pattern as shown in Figures VIII-1 and VIII-2, along the following streets: Boylston, Hadassar, Providence, St. James, Dartmouth and once again Boylston. At the intersection of Boylston and Hereford, the sewage flow enters the West Side Interceptor (WSI) as the next leg in transport to the Deer Island Treatment Facility.

Under extreme wet weather conditions or if blockages occur in the sanitary sewer downstream of the site, flow can be diverted at the common Manholes 68, 70, 71 and 72 to the storm drain which runs parallel to the sanitary sewer in the vicinity of these manholes. This storm drain passes below the Public Gardens enroute to connection with the WSI at the intersection of Beacon and Brimmer Streets.

The WSI serves the west side of Boston beginning near North Station and extending south down Charles Street to Beacon Street. It turns south down Hereford Street to Dalton Street and then to Huntington Avenue. At the intersection of Huntington Avenue and Gainsborough Street, the WSI connects to the head end of the Boston Main Interceptor (BMI).

The BMI normally discharges to the Massachusetts Water Resources Authority (MWRA) owned Boston Main Drainage Relief Sewer at the intersection of Tremont Street and Camden Street. This main relief sewer carries wastewater and storm water to the MWRA Ward Street Headworks near Huntington and Longwood Avenues. The Ward Street Headworks discharges to the MWRA Boston Main Drainage Tunnel which conveys the

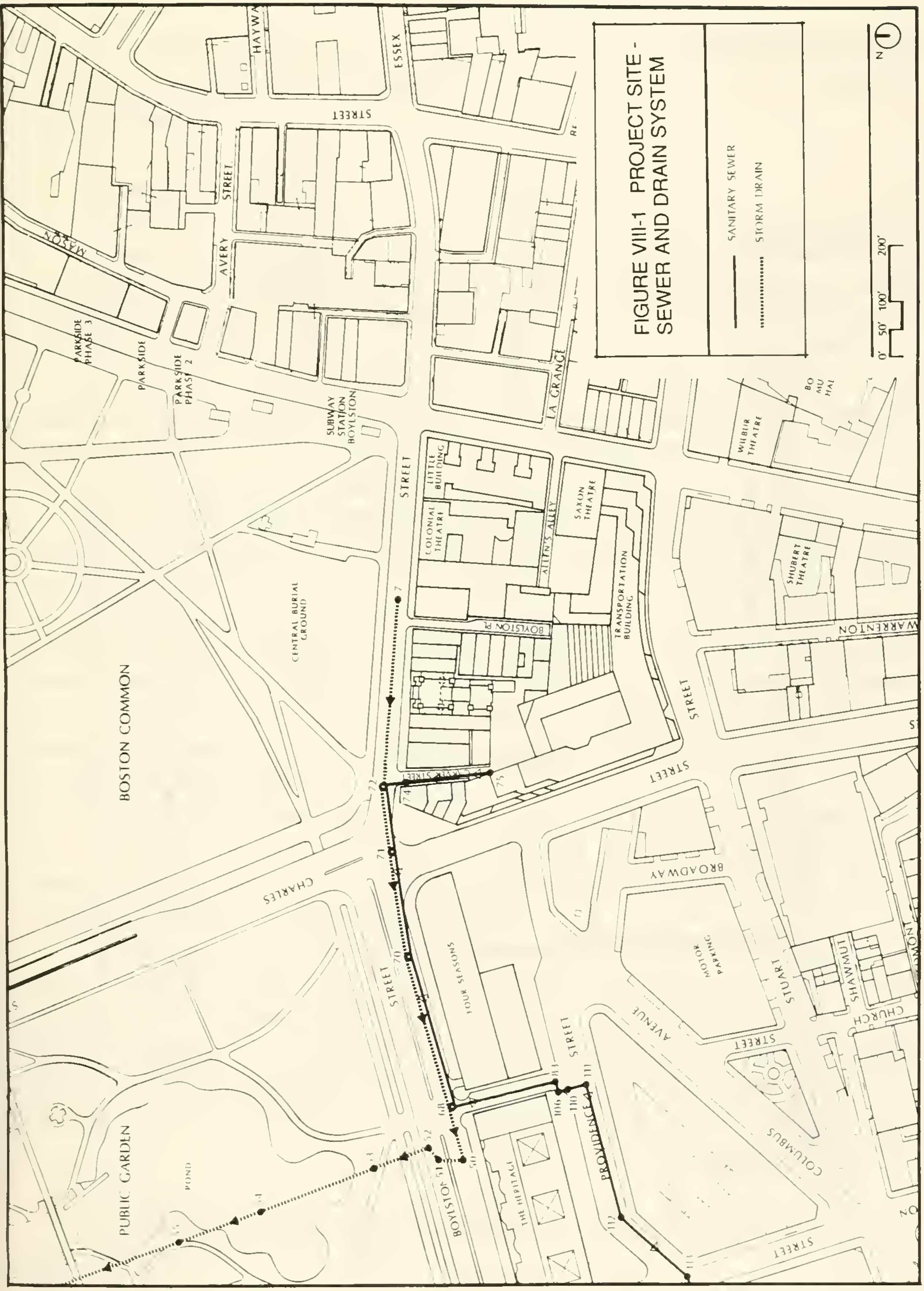


FIGURE VIII-1 PROJECT SITE - SEWER AND DRAIN SYSTEM

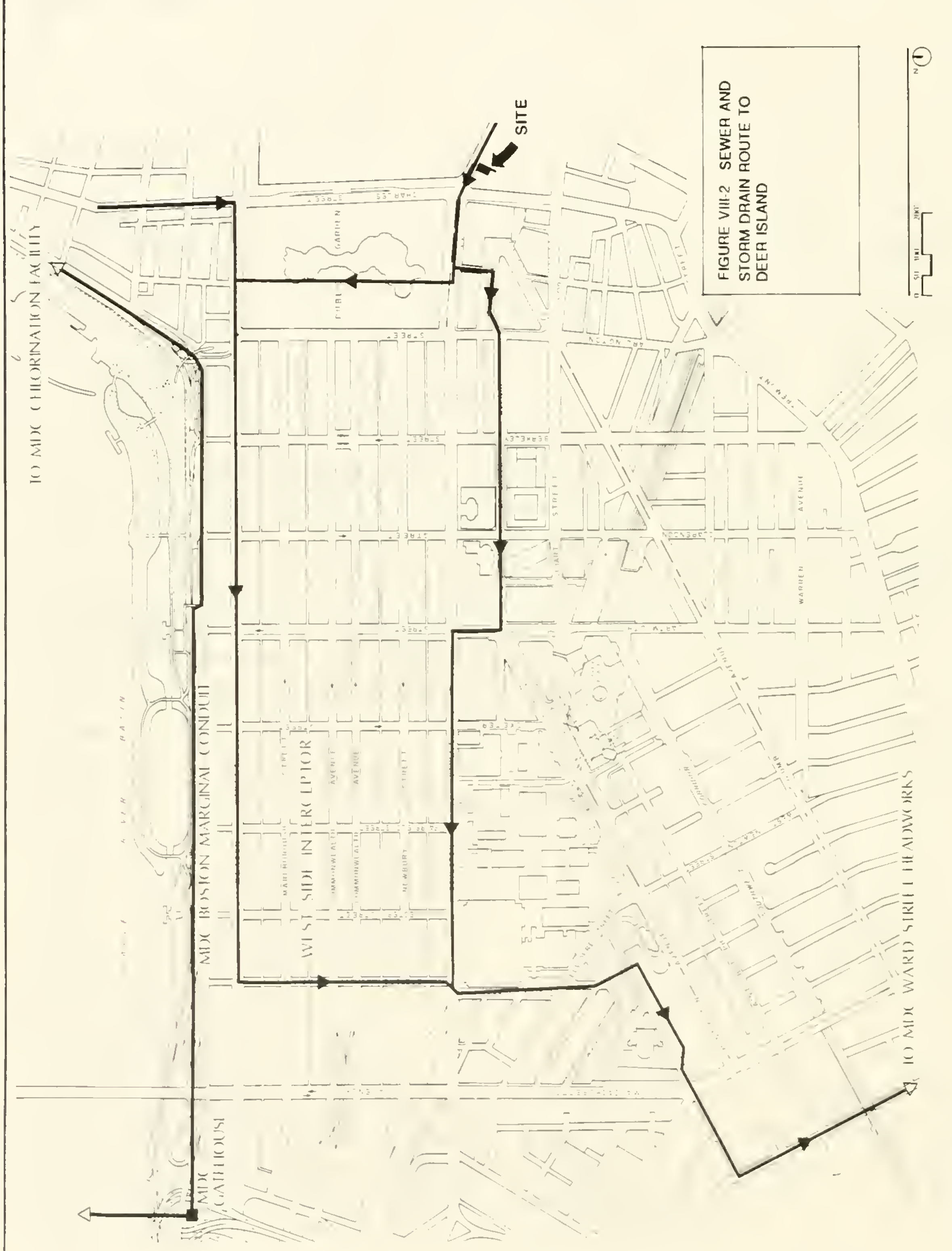


FIGURE VIII-2 SEWER AND STORM DRAIN ROUTE TO DEER ISLAND

flows to the Deer Island Treatment Facility. At Deer Island, wastewater currently receives primary treatment and chlorination prior to discharge to Boston Harbor at President's Roads.

Existing Capacity Analysis

A system capacity evaluation was conducted for applicable sewer segments. Results of the numerical analysis for the sanitary sewer segments using Manning's Equation with a coefficient of roughness of 0.015 is presented in Table VIII-1. Information regarding the storm drain system is contained in Table VIII-2.

The sanitary sewer analysis provides information on sewer location, size and capacity. Listed information and input data for the capacity calculations was obtained from BWSC maps. For calculation purposes, non-circular sections were converted mathematically to circular sections using conventional formulas.

Results of the capacity calculations indicate moderate to good conditions for most segments of the flow route. The lowest capacity calculated was for the section along Hadassah Way. A short uphill section contributed to the capacity value obtained. Under sewage and storm water flow conditions which exceed this capacity, the sewer segment will flow full and become surcharged. This condition results in an increase in capacity which is related to the residual pressure head, produced from the surcharge condition. Analysis indicates that with only minor surcharging of less than one foot of pressure head, which should be well below local basement levels, the capacity increases to approximately 1.5 million gallons per day (mgd).

Contact with the BWSC staff* confirmed that this sewer route handles normal dry and wet weather flow without problems associated with system capacity. Problems that have been reported concern system backup along Boylston Street resulting from physical plugging due to grease discharges from a local hotel.

Extreme wet weather flows that could potentially exceed the capacity of the sanitary sewer in the Boylston Street area can be discharged via the overflow devices contained in the common Manholes 68, 70, 71 and 72. This overflow enters the storm drain system presented in Table VIII-2 which runs along Boylston Street before turning north to pass under the Public Gardens on its way to the WSI at Beacon and Brimmer Streets.

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* Donald Kerrissey, BWSC, Boston, MA, 7/26/88.

TABLE VIII-1

SANITARY SEWER CAPACITY EVALUATION

Segment MH-MH	Street Location	Sewer Size(in)	Segment Length(ft)	Slope (ft/ft)	Capacity (mgd)	Sewer Type
75-74	Carver	20x23	155	Unk	-	Sanitary
74-72	Carver	20x30	35	Unk	-	Sanitary
72-68	Boylston	10	600	0.0083	1.12	Sanitary
68-106	Hadassah	12	195	0.0008	0.57	Sanitary
106-110	Hadassah	22	15	0.0093	9.73	Sanitary
110-113	Providence	22	450	0.0002	1.50	Sanitary
113-124	St. James	22	450	0.0005	2.33	Sanitary
124-137	St. James	22	260	0.0003	1.77	Sanitary
137-151	St. James	30	305	0.0002	2.95	Sanitary
151-150	St. James	30	280	0.0006	5.50	Sanitary
150-173	St. James	30	315	0.0006	5.66	Sanitary
173-177	St. James	30	140	0.0002	3.37	Sanitary
177-42	St. James	30	190	0.0001	2.36	Sanitary
42-365	Dartmouth	30	180	0.0087	21.51	Sanitary
365-317	Boylston	30	475	0.0008	6.60	Sanitary
317-27	Boylston	30	100	0.0006	5.60	Sanitary
27-25	Boylston	48x24	80	0.0006	5.60	Sanitary
25-24	Boylston	30	40	0.0006	5.60	Sanitary
24-104	Boylston	30	210	0.0010	5.91	Sanitary
104-103	Boylston	30	195	0.0010	6.14	Sanitary
103-102	Boylston	30	190	0.0011	7.47	Sanitary
102-100	Boylston	33x39	360	0.0008	16.30	Sanitary
100-99	Boylston	33x39	240	0.0013	19.97	Sanitary
99-WSI	Boylston	33x39	500	Unk	-	Sanitary

NOTES:
- Manhole numbers keyed to BWSC maps.
- Capacity from Manning's Equation with a coefficient of roughness of 0.015 (fair condition brick or concrete).
- Non-circular sewer sections converted to equivalent diameters for capacity calculations.

TABLE VIII-2

STORM DRAIN INFORMATION

Segment MH-MH	Street Location	Sewer Size(in)	Segment Length(ft)	Drain Type
7-72*	Boylston	15	215	Combined
72-73	Boylston	26x39	60	Storm
73-71	Boylston	26x39	55	Storm
71-70	Boylston	26x39	180	Storm
70-69	Boylston	26x39	150	Storm
69-68	Boylston	26x39	150	Storm
68-49	Boylston	26x39	45	Storm
49-50	Boylston	26x39	50	Storm
50-51	Boylston	87x72	50	Storm
51-52	Boylston	78x78	35	Storm
52-53	Public Garden	52x48	80	Storm
53-54	Public Garden	52x48	210	Storm
54-55	Public Garden	52x48	150	Storm
55-56	Public Garden	52x48	355	Storm
56-157	Public Garden	52x48	290	Storm
157-156	Public Garden	52x48	210	Storm
156-WSI	Beacon	52x48	50	Storm

NOTES: - Manhole numbers keyed to BWSC maps.

Information describing the storm drain system from the site to the WSI was obtained from the BWSC. An evaluation based on discussions with the BWSC staff** indicates that this system functions well under typical wet weather conditions with no reports of street or basement flooding due to system capacity.

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* Commonly discharges to sanitary sewer segment exiting MH 72. Under extreme wet weather conditions, overflows to storm drain system.

** Daniel Kerrissey, BWSC, Boston, MA, 7/26/88.

Sewage and Storm Water Generation

The proposed development contains approximately 140,000 square feet on 16 levels, including the two basement levels and the mechanical penthouse. For calculation purposes, this space is segmented into the use categories of retail, office, residential, and health club. This information, combined with typical reference information, was used to obtain the average sewage generation rates reported in Table VIII-3. The total average daily rate was calculated to be 11,727 gpd.

TABLE VIII-3

AVERAGE DAILY SEWAGE GENERATION RATES*

Space Application	Estimated Flow (gal/day)
Commercial	1,157
Residential	9,570
Health Club	1,000
TOTAL	11,727

Because sewage generation rates vary with daily cycle, a peaking factor of 3.0 (times the total average daily rate) is used to determine peak dry weather flow for this project. By multiplication, a peak value of 35,180 gpd is projected. Because the majority of space is for residential use, peak generation rates are expected to occur during early morning or early evening hours.

The current impervious conditions at the site result in total run-off of storm water. Because no change in this condition is planned as part of the development, storm water run-off will remain essentially unchanged.

Proposed Sewer and Storm Water Connections and Impact

It is proposed that the discharge of sanitary wastewater be to Manhole 75 on Carver Street. This connection can easily be made from the rear of the proposed structure. By connecting to a sanitary sewer segment of the overall system, the general policy of

* Based on Massachusetts State Environmental Code, 310 CMR 15.00, Title 5.

segregation of sewage from storm water is achieved. Based on the capacity analysis conducted and the sewage generation information developed, the prescribed sanitary sewer route will be able to accept this flow for transfer to the Deer Island Treatment Facility without incident.

Storm water will be directed to the 15 inch combined sewer in Boylston Street which currently handles storm water discharges from the area without difficulty. Because there will be no net increase in storm water flows from the site, there will be no change in impact on the storm drain system.

2.2 Water Distribution System

Description of Existing Facilities

The water distribution system at the project site area is owned and operated by BWSC (see Figure VIII-3). The area is well served by both Southern High and Southern Low service mains, some of which have been recently relined or replaced. On Boylston Street, 12 inch Southern High and 12 inch Southern Low water mains pass directly in front of the proposed development.

Existing Capacity Analysis

Water supply capacity in the general area of the project site is considered to be good by BWSC staff*, with no known problems. The system in this vicinity has been upgraded over recent years and fire flow/hydrant tests (Table VIII-4) support the conclusion that excess capacity exists to deliver water to users in this area.

Project Water Demand

An estimate of the domestic water demand was calculated based on design sewage generation rate information.** From this computation, an average daily water demand of 12,899 gallons was obtained (Table VIII-5). A typical peaking factor of 3.0 was used to calculate the expected maximum flow demand rate. This calculation resulted in a peak demand of 38,700 gpd or 27 gpm.

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* David Crehan, BWSC, Boston, MA, July 22, 1988.

** Massachusetts State Environmental Code, 310 CMR 15.00, Title 5.

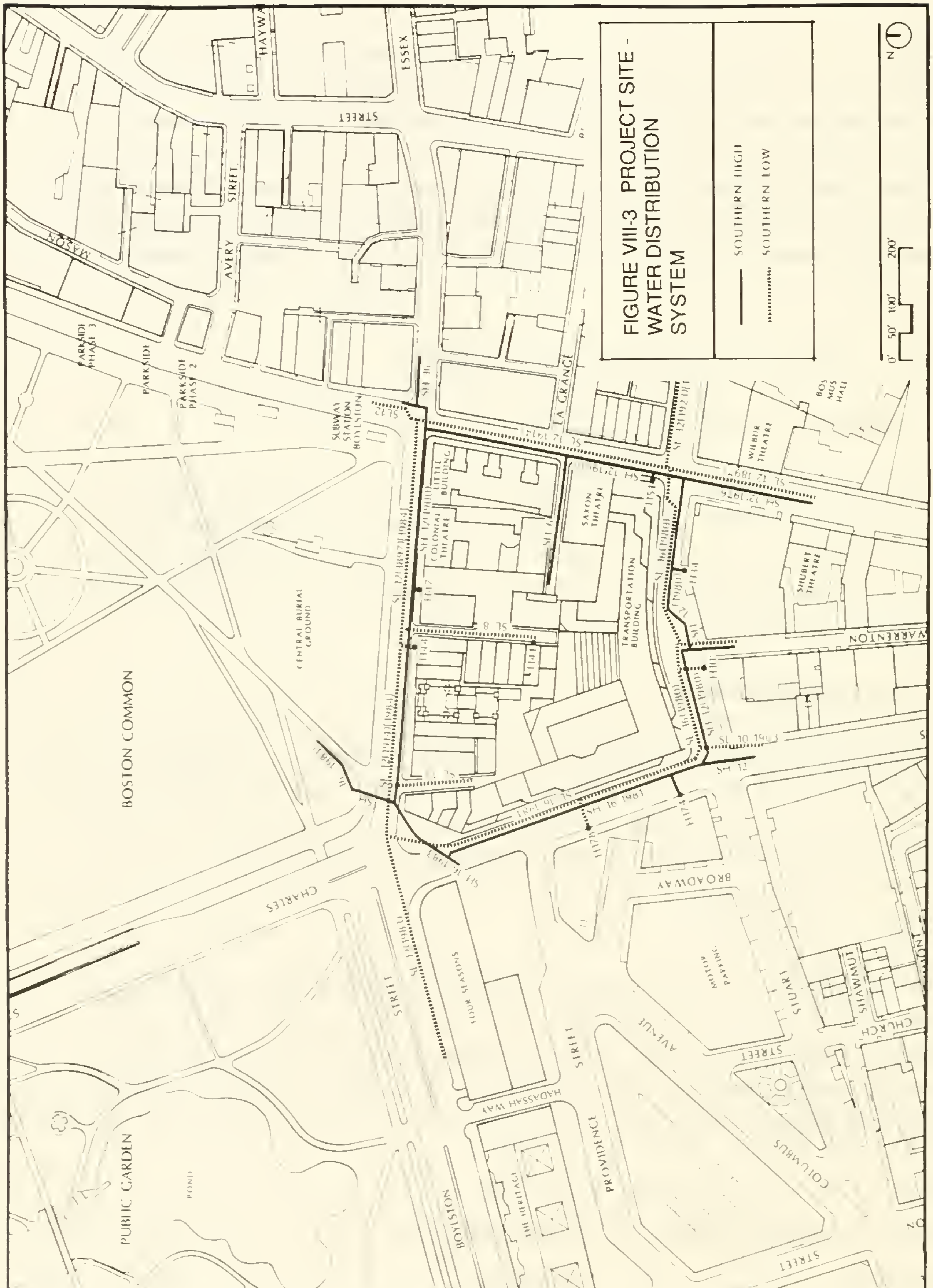
FIGURE VIII-3 PROJECT SITE - WATER DISTRIBUTION SYSTEM
SOUTHERN HIGH
SOUTHERN LOW
0' 50' 100' 200'
N
BOSTON COMMON
PUBLIC GARDEN
POND
CENTRAL BURIAL GROUND
PARKSIDE PHASE 3
PARKSIDE
PARKSIDE PHASE 2
SUBWAY STATION BOYLSTON
LITTLE BUILDING
COLONIAL THEATRE
SAXON THEATRE
TRANSPORTATION BUILDING
WILBUR THEATRE
SHUBERT THEATRE
FOUR SEASONS
MOTOR PARKING
THE HERITAGE
HAYWARD
ESSEX
STREET
AVERY STREET
MASON
LA GRANGE
WARRENTON
CHARLES
STREET
BOYLSTON
HADASSAH WAY
PROVIDENCE
STREET
AVENUE
COLUMBUS
BROADWAY
STUART
STREET
SHAWMUT
CHURCH
STREET

TABLE VIII-4

FIRE FLOW/HYDRANT TESTS*

Street/ Location	Service	Date	Static Press(psi)	Flow (gpm) @ Resid Press(psi)	Flow (gpm) @ Resid Press of 20 psi**
Carver and Boylston	SL 16"	7/85	55	3,600 @ 47	8,000
Carver and Boylston	SH 16"	7/85	94	4,890 @ 82	13,060
Carver and Eliot	SH 16"	3/87	95	1,710 @ 90	7,330

TABLE VIII-5

AVERAGE DAILY WATER DEMAND***

Space Application	Estimated Flow (gal/day)
Commercial	1,272
Residential	10,527
Health Club	1,100
TOTAL (Domestic Only)	12,899
Cooling Requirements	20,394

* Test data obtained from BWSC, Boston, MA.

** Calculated.

*** Based on Massachusetts State Environmental Code, 310 CMR 15.00, Title 5.

Other demands on the distribution system are for air conditioning, cooling tower makeup, and fire fighting requirements. Cooling tower makeup is expected to average 20,390 gpd during summer months with a peak of 61,200 gpd or 42 gpm. The typical fire flow requirement is set at 1500 gpm.

Proposed Water Connections and Impact

Both Southern High and Southern Low mains are available on Boylston Street to serve the site. As a result, the BWSC preference can be met that domestic service connections be made to Southern Low mains and fire protection connections be made to the Southern High mains.

The maximum water demand for domestic use and cooling water makeup is calculated to be 69 gpm (27 gpm + 42 gpm). Based on the data contained in Table VIII-4, it is clear that the Southern Low system has sufficient capacity to meet this demand. The test results reported for the Southern Low system in the project vicinity show a capacity of 3,600 gpm at 47 psi.

The fire flow requirement of 1500 gpm can adequately be satisfied by the Southern High system. Fire flow/hydrant test data contained in Table VIII-4 show a capacity of 4,890 gpm at 82 psi for a location near the proposed development.

2.3 Permitting Requirements

New construction projects require a sewer connection permit and approval of water service connection plans. For new sewer connections, an application is made for a sewer connection permit in accordance with 324 CMR 7.00. Design plans and specifications are submitted to BWSC. This information is reviewed and then forwarded to the Department of Environmental Quality Engineering - Division of Water Pollution Control. Sewer connection permit applications must be submitted ninety days prior to installation of the connection.

Water service connection plans must also be submitted to the BWSC for review. This review is to ensure that water system connections are made in accordance with BWSC standards.

2.4 Mitigation - Water Use and Sewage Generation

There are several strategies for reducing the estimated impact of the development on the existing water supply and wastewater collection and disposal systems. Because of the conditions affecting each of the these systems, conservation methods are in order. The project proponent proposes to include the following mitigation measures:

- Water conserving toilets will be installed that exceed the requirements of the State Building Code. Where the code requires that tank type toilets use a maximum of 3 gal/flush and flushometers use a maximum of 3.5 gal/flush, toilet units that use 1.6 gal/flush will be installed.

- As an added water conservation effort which will also reduce wastewater generation, low flow shower heads will be installed. These devices will reduce shower flow rates from 2 to 3 gpm to approximately 1 gpm.

- The proponent is willing to participate in regional programs to eliminate excess flows from the MWRA system. In association with development of the new secondary treatment plant at Deer Island, the MWRA has committed to an aggressive program to avoid overloading the new treatment facilities. Various programs are being evaluated to eliminate excess flows. One example is the "Sewer Bank" concept. Once MWRA establishes its program, the proponent is prepared to participate as appropriate.

- Parking garage drains will be discharged via oil/water separators and catch basins to minimize the level and impact of potential pollutants such as oil, grease, gasoline, suspended solids and the associated organic loading on the BWSC sewage collection and treatment systems. The separators and catch basins will be routinely monitored and maintained by the proponent.

3.0 Electric Power Service

3.1 Description of Existing Facilities

The Boston Edison Company provides electrical power in the project site area. This power is supplied through their distribution network located in the adjacent public ways. Discussions with Boston Edison staff* indicates that adequate high voltage capacity is available to supply all of the development needs. However, this power must be transformed to the appropriate voltage level for use. The transformer facilities are to be housed in a vault space located within the proposed structure and are subject to Boston Edison Company approval.

3.2 Power Use and Service Requirements

The proposed development will satisfy all of its energy and power requirements electrically. In addition to the typical electric power uses, hot water and space heating will also be electrical. The energy efficient space heating-cooling system to be specified will use a continuous water loop throughout the structure as the heat sink or source with individual heat pumps located in each unit or use area to provide heating or cooling. This type of system incorporates an important measure of conservation by providing a mode for the balancing of heating and cooling needs throughout the proposed structure.

Table VIII-6 provides an estimate of anticipated electric power requirements for the proposed project. The tabulated information was developed using typical usage factors for an all electric facility.**

In addition to the energy efficient heating-cooling system, the proponent plans to incorporate other energy conservation procedures. These efforts are designed to comply with the requirements contained in the recently revised (July 1, 1988) Article 20, Energy Conservation, of the Massachusetts State Building Code.

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* Larry Denehy, Boston Edison Company, Boston, MA.

** Energy Performance Standards for New Buildings, Federal Register 44 CFR 230, November 28, 1979.

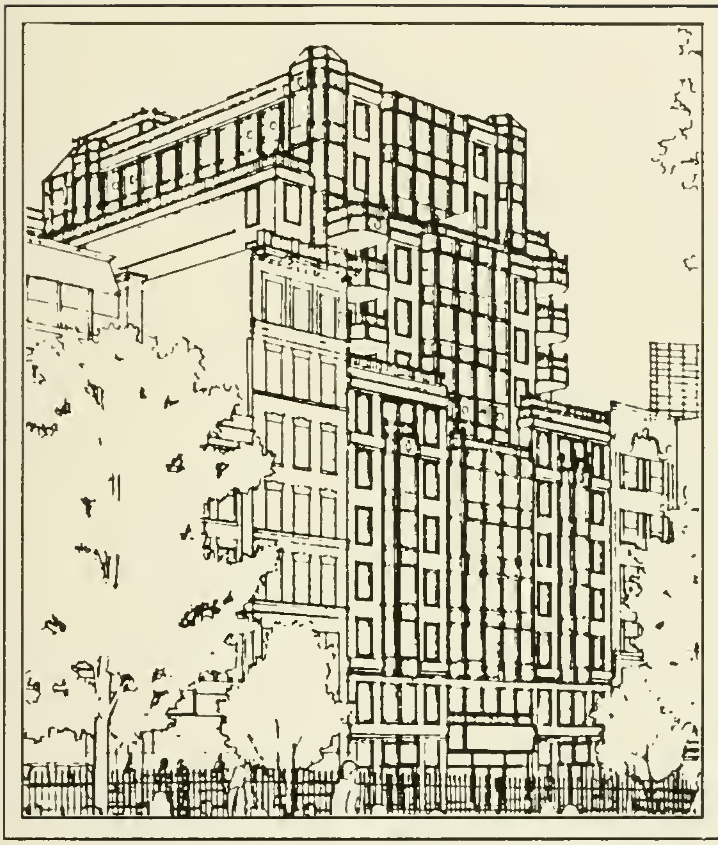
TABLE VIII-6

ENERGY REQUIREMENTS FOR

HEATING-COOLING AND OTHER USES*

Space Application	Estimated Energy Use (KWH/yr)
Commercial	65.3×10^4
Residential	261.1×10^4
Health Club	4.3×10^4
TOTAL	330.7×10^4

* Based on Energy Performance Standards for New Buildings, Federal Register 44 CFR 230, Nov. 28, 1979.



APPENDICES

APPENDIX A

TRAFFIC LEVEL OF SERVICE CALCULATIONS

144 BOYLSTON ST. PPEX5P

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
TREMONT STREET @
TREMONT STREET
WEEKDAY PM EXISTING CBD ? Y
PRETIMED SIGNAL

V O L U M E   A D J U S T M E N T

APPROACH	LANE MVM	GROUP VOLUME	FLOW RATE IN GROUP	LANE UTIL FACTOR	ADJ FLOW RATE	PROP OF TURNS LT	RT
EB	TR	702	780	1.00	780	0.00	0.27
WB							
NB							
SB	LT	450	500	1.00	500	0.31	0.00
	T	676	751	1.00	751	0.00	0.00
	R	374	416	1.00	416	0.00	1.00

S A T U R A T I O N   F L O W

APP	MVM	IDEAL SAT FLOW	# OF LANES	ADJUSTMENT FACTORS WIDTH	H.V.	GRADE	PARK	BUS	AREA	RT	LT	ADJ. FLOW
EB	TR	1800	2	0.99	1.00	1.00	1.00	1.00	0.90	0.96	1.00	3078
WB												
NB												
SB	LT	1800	1	0.97	1.00	1.00	1.00	1.00	0.90	1.00	0.95	1499
	T	1800	2	0.97	1.00	1.00	1.00	1.00	0.90	1.00	1.00	3143
	R	1800	1	0.97	1.00	1.00	1.00	1.00	0.90	0.85	1.00	1336

144 BOYLSTON ST. PPEX5P

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
TREMONT STREET @
TREMONT STREET
WEEKDAY PM EXISTING CBD ? Y
PRETIMED SIGNAL

C A P A C I T Y   A N A L Y S I S

APP	LN GR MVM	ADJ FLOW RATE	PMSV LT FLOW	ADJ SAT FLW RT	FLOW RATIO	CRIT ?	GREEN RATIO	LN GR CAPACITY	V/C RATIO
EB	TR	780	0	3078	0.253	Y	0.300	923	0.845
WB									
NB									
SB	LT	500	0	1499	0.334	Y	0.422	633	0.790
	T	751	0	3143	0.239	N	0.422	1327	0.566
	R	416	0	1336	0.311	N	0.422	564	0.738

CYCLE LENGTH : 90.0 SUM OF CRITICAL LANES' FLOW RATIOS : 0.587
LOSS TIME PER CYCLE : 6 INTERSECTION V/C : 0.629

L E V E L   O F   S E R V I C E

APP	LN GR MVM	V/C RATIO	GREEN RATIO	CYC LEN	1st DELAY	LN GR CAP	2nd DELAY	PF	LN GR DELAY	LN GR LOS	APP DELAY	APP LOS
EB	TR	0.845	0.300	90	22.4	923	5.1	1.00	27.5	D	27.4	D
WB												
NB												
SB	LT	0.790	0.422	90	17.1	633	4.7	1.00	21.8	C		
	T	0.566	0.422	90	15.0	1327	0.4	1.00	15.4	C		
	R	0.738	0.422	90	16.6	564	3.5	1.00	20.1	C	18.5	C

INTERSECTION DELAY : 21.3 secs/veh
LEVEL OF SERVICE : C

144 BOYLSTON ST. PP905P

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
TREMONT STREET @
TREMONT STREET
WEEKDAY PM 90 NO BUILD CBD ? Y
PRETIMED SIGNAL

V O L U M E   A D J U S T M E N T

APPROACH	LANE GROUP MVM	VOLUME	FLOW RATE IN GROUP	LANE UTIL FACTOR	ADJ FLOW RATE	PROP OF TURNS LT	RT
EB	TR	730	811	1.00	811	0.00	0.27
WB							
NB							
SB	LT	469	521	1.00	521	0.31	0.00
	T	703	781	1.00	781	0.00	0.00
	R	389	432	1.00	432	0.00	1.00

S A T U R A T I O N   F L O W

APP	MVM	IDEAL SAT FLOW	# OF LANES	WIDTH	H.V.	GRADE	PARK	BUS	AREA	RT	LT	ADJ. FLOW
				--ADJUSTMENT FACTORS--								
EB	TR	1800	2	0.99	1.00	1.00	1.00	1.00	0.90	0.96	1.00	3078
WB												
NB												
SB	LT	1800	1	0.97	1.00	1.00	1.00	1.00	0.90	1.00	0.95	1499
	T	1800	2	0.97	1.00	1.00	1.00	1.00	0.90	1.00	1.00	3143
	R	1800	1	0.97	1.00	1.00	1.00	1.00	0.90	0.85	1.00	1336

144 BOYLSTON ST. PP905P

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
TREMONT STREET @
TREMONT STREET
WEEKDAY PM 90 NO BUILD CBD ? Y
PRETIMED SIGNAL

C A P A C I T Y A N A L Y S I S

APP	LN GR MVM	ADJ FLOW RATE	PMSV LT FLOW	ADJ SAT FLW RT	FLOW RATIO	CRIT ?	GREEN RATIO	LN GR CAPACITY	V/C RATIO
EB	TR	811	0	3078	0.263	Y	0.300	923	0.879
WB									
NB									
SB	LT	521	0	1499	0.348	Y	0.422	633	0.823
	T	781	0	3143	0.248	N	0.422	1327	0.589
	R	432	0	1336	0.323	N	0.422	564	0.766

CYCLE LENGTH : 90.0 SUM OF CRITICAL LANES' FLOW RATIOS : 0.611
LOSS TIME PER CYCLE : 6 INTERSECTION V/C : 0.655

L E V E L O F S E R V I C E

APP	LN GR MVM	V/C RATIO	GREEN RATIO	CYC LEN	1st DELAY	LN GR CAP	2nd DELAY	PF	LN GR DELAY	LN GR LOS	APP DELAY	APP LOS
EB	TR	0.879	0.300	90	22.8	923	6.9	1.00	29.7	D	29.6	D
WB												
NB												
SB	LT	0.823	0.422	90	17.5	633	6.0	1.00	23.5	C		
	T	0.589	0.422	90	15.2	1327	0.5	1.00	15.7	C		
	R	0.766	0.422	90	16.9	564	4.3	1.00	21.2	C	19.4	C

INTERSECTION DELAY : 22.6 secs/veh
LEVEL OF SERVICE : C

144 BOYLSTON ST. PP905PB

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
TREMONT STREET @
TREMONT STREET
WEEKDAY PM 90 BUILD CBD ? Y
PRETIMED SIGNAL

V O L U M E   A D J U S T M E N T

APPROACH	LANE MVM	GROUP VOLUME	FLOW RATE IN GROUP	LANE UTIL FACTOR	ADJ FLOW RATE	PROP OF TURNS LT	RT
EB	TR	735	817	1.00	817	0.00	0.27
WB							
NB							
SB	LT	469	521	1.00	521	0.31	0.00
	T	703	781	1.00	781	0.00	0.00
	R	391	434	1.00	434	0.00	1.00

S A T U R A T I O N   F L O W

APP	MVM	IDEAL SAT FLOW	# OF LANES	WIDTH	H.V.	GRADE	PARK	BUS	AREA	RT	LT	ADJ. FLOW
				ADJUSTMENT FACTORS								
EB	TR	1800	2	0.99	1.00	1.00	1.00	1.00	0.90	0.96	1.00	3078
WB												
NB												
SB	LT	1800	1	0.97	1.00	1.00	1.00	1.00	0.90	1.00	0.95	1499
	T	1800	2	0.97	1.00	1.00	1.00	1.00	0.90	1.00	1.00	3143
	R	1800	1	0.97	1.00	1.00	1.00	1.00	0.90	0.85	1.00	1336

144 BOYLSTON ST. PP905PB

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
TREMONT STREET @
TREMONT STREET
WEEKDAY PM 90 BUILD CBD ? Y
PRETIMED SIGNAL

C A P A C I T Y   A N A L Y S I S

APP	LN GR MVM	ADJ FLOW RATE	PMSV LT FLOW	ADJ SAT FLW RT	FLOW RATIO	CRIT ?	GREEN RATIO	LN GR CAPACITY	V/C RATIO
EB	TR	817	0	3078	0.265	Y	0.300	923	0.885
WB									
NB									
SB	LT	521	0	1499	0.348	Y	0.422	633	0.823
	T	781	0	3143	0.248	N	0.422	1327	0.589
	R	434	0	1336	0.325	N	0.422	564	0.770

CYCLE LENGTH : 90.0 SUM OF CRITICAL LANES' FLOW RATIOS : 0.613
LOSS TIME PER CYCLE : 6 INTERSECTION V/C : 0.657

L E V E L   O F   S E R V I C E

APP	LN GR MVM	V/C RATIO	GREEN RATIO	CYC LEN	1st DELAY	LN GR CAP	2nd DELAY	PF	LN GR DELAY	LN GR LOS	APP DELAY	APP LOS
EB	TR	0.885	0.300	90	22.8	923	7.3	1.00	30.1	D	30.0	D
WB												
NB												
SB	LT	0.823	0.422	90	17.5	633	6.0	1.00	23.5	C		
	T	0.589	0.422	90	15.2	1327	0.5	1.00	15.7	C		
	R	0.770	0.422	90	16.9	564	4.5	1.00	21.4	C	19.5	C

INTERSECTION DELAY : 22.8 secs/veh
LEVEL OF SERVICE : C

144 BOYLSTON ST. PPEX4P1

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
CHARLES STREET @
CHARLES STREET
WEEKDAY PM EXISTING CBD ? Y
PRETIMED SIGNAL

V O L U M E   A D J U S T M E N T

APPROACH	LANE MVM	GROUP VOLUME	FLOW RATE IN GROUP	LANE UTIL FACTOR	ADJ FLOW RATE	PROP OF TURNS LT	RT
EB	L	650	722	1.00	722	1.00	0.00
	T	545	606	1.00	606	0.00	0.00
WB	R	374	416	1.00	416	0.00	1.00
NB	TR	1052	1169	1.00	1169	0.00	0.15
SB							

S A T U R A T I O N   F L O W

APP	MVM	IDEAL SAT FLOW	# OF LANES	ADJUSTMENT FACTORS WIDTH	H.V.	GRADE	PARK	BUS	AREA	RT	LT	ADJ. FLOW
EB	L	1800	2	1.13	1.00	1.00	1.00	1.00	0.90	1.00	0.92	3368
	T	1800	2	1.05	1.00	1.00	1.00	1.00	0.90	1.00	1.00	3402
WB	R	1800	1	1.00	1.00	1.00	1.00	1.00	0.90	0.85	1.00	1377
NB	TR	1800	3	1.00	1.00	1.00	1.00	1.00	0.90	0.98	1.00	4751
SB												

144 BOYLSTON ST. PPEX4P1

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
CHARLES STREET @
CHARLES STREET
WEEKDAY PM EXISTING CBD ? Y
PRETIMED SIGNAL

C A P A C I T Y   A N A L Y S I S

APP	LN GR MVM	ADJ FLOW RATE	PMSV LT FLOW	ADJ SAT FLW RT	FLOW RATIO	CRIT ?	GREEN RATIO	LN GR CAPACITY	V/C RATIO
EB	L	722	0	3368	0.214	N	0.356	1198	0.603
	T	606	0	3402	0.178	N	0.356	1210	0.501
WB	R	416	0	1377	0.302	Y	0.356	490	0.849
NB	TR	1169	0	4751	0.246	Y	0.333	1584	0.738
SB									

CYCLE LENGTH : 90.0 SUM OF CRITICAL LANES' FLOW RATIOS : 0.548
LOSS TIME PER CYCLE : 6 INTERSECTION V/C : 0.587

L E V E L   O F   S E R V I C E

APP	LN GR MVM	V/C RATIO	GREEN RATIO	CYC LEN	1st DELAY	LN GR CAP	2nd DELAY	PF	LN GR DELAY	LN GR LOS	APP DELAY	APP LOS
EB	L	0.603	0.356	90	18.1	1198	0.6	1.00	18.7	C		
	T	0.501	0.356	90	17.3	1210	0.3	1.00	17.6	C	18.2	C
WB	R	0.849	0.356	90	20.3	490	9.2	1.00	29.5	D	29.4	D
NB	TR	0.738	0.333	90	20.2	1584	1.3	1.00	21.5	C	21.5	C
SB												

INTERSECTION DELAY : 21.1 secs/veh
LEVEL OF SERVICE : C

144 BOYLSTON ST. PP904P1

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
CHARLES STREET @
CHARLES STREET
WEEKDAY PM 90 NO BUILD CBD ? Y
PRETIMED SIGNAL

V O L U M E   A D J U S T M E N T

APPROACH	LANE GROUP MVM	VOLUME	FLOW RATE IN GROUP	LANE UTIL FACTOR	ADJ FLOW RATE	PROP OF TURNS LT	RT
EB	L	676	751	1.00	751	1.00	0.00
	T	567	630	1.00	630	0.00	0.00
WB	R	389	432	1.00	432	0.00	1.00
NB	TR	1094	1216	1.00	1216	0.00	0.15
SB							

S A T U R A T I O N   F L O W

APP	MVM	IDEAL SAT FLOW	# OF LANES	WIDTH	H.V.	GRADE	PARK	BUS	AREA	RT	LT	ADJ. FLOW
EB	L	1800	2	1.13	1.00	1.00	1.00	1.00	0.90	1.00	0.92	3368
	T	1800	2	1.05	1.00	1.00	1.00	1.00	0.90	1.00	1.00	3402
WB	R	1800	1	1.00	1.00	1.00	1.00	1.00	0.90	0.85	1.00	1377
NB	TR	1800	3	1.00	1.00	1.00	1.00	1.00	0.90	0.98	1.00	4751
SB												

(WIDTH through LT are ADJUSTMENT FACTORS)

144 BOYLSTON ST. PP904P1

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
CHARLES STREET @
CHARLES STREET
WEEKDAY PM 90 NO BUILD CBD ? Y
PRETIMED SIGNAL

C A P A C I T Y   A N A L Y S I S

APP	LN GR MVM	ADJ FLOW RATE	PMSV LT FLOW	ADJ SAT FLW RT	FLOW RATIO	CRIT ?	GREEN RATIO	LN GR CAPACITY	V/C RATIO
EB	L	751	0	3368	0.223	N	0.356	1198	0.627
	T	630	0	3402	0.185	N	0.356	1210	0.521
WB	R	432	0	1377	0.314	Y	0.356	490	0.882
NB	TR	1216	0	4751	0.256	Y	0.333	1584	0.768
SB									

CYCLE LENGTH : 90.0 SUM OF CRITICAL LANES' FLOW RATIOS : 0.570
LOSS TIME PER CYCLE : 6 INTERSECTION V/C : 0.611

L E V E L   O F   S E R V I C E

APP	LN GR MVM	V/C RATIO	GREEN RATIO	CYC LEN	1st DELAY	LN GR CAP	2nd DELAY	PF	LN GR DELAY	LN GR LOS	APP DELAY	APP LOS
EB	L	0.627	0.356	90	18.3	1198	0.8	1.00	19.1	C		
	T	0.521	0.356	90	17.4	1210	0.3	1.00	17.7	C	18.4	C
WB	R	0.882	0.356	90	20.7	490	11.9	1.00	32.6	D	32.4	D
NB	TR	0.768	0.333	90	20.4	1584	1.6	1.00	22.0	C	22.0	C
SB												

INTERSECTION DELAY : 21.8 secs/veh
LEVEL OF SERVICE : C

144 BOYLSTON ST. PP904BP

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
CHARLES STREET @
CHARLES STREET
WEEKDAY PM 90 BUILD CBD ? Y
PRETIMED SIGNAL

V O L U M E   A D J U S T M E N T

APPROACH	LANE MVM	GROUP VOLUME	FLOW RATE IN GROUP	LANE UTIL FACTOR	ADJ FLOW RATE	PROP OF TURNS LT	RT
EB	L	676	751	1.00	751	1.00	0.00
	T	571	634	1.00	634	0.00	0.00
WB	R	392	436	1.00	436	0.00	1.00
NB	TR	1105	1228	1.00	1228	0.00	0.15
SB							

S A T U R A T I O N   F L O W

APP	MVM	IDEAL SAT FLOW	# OF LANES	ADJUSTMENT FACTORS: WIDTH	H.V.	GRADE	PARK	BUS	AREA	RT	LT	ADJ. FLOW
EB	L	1800	2	1.13	1.00	1.00	1.00	1.00	0.90	1.00	0.92	3368
	T	1800	2	1.05	1.00	1.00	1.00	1.00	0.90	1.00	1.00	3402
WB	R	1800	1	1.00	1.00	1.00	1.00	1.00	0.90	0.85	1.00	1377
NB	TR	1800	3	1.00	1.00	1.00	1.00	1.00	0.90	0.98	1.00	4751
SB												

144 BOYLSTON ST. PP904BP

INTERSECTION :
BOYLSTON STREET @
BOYLSTON STREET @
CHARLES STREET @
CHARLES STREET
WEEKDAY PM 90 BUILD CBD ? Y
PRETIMED SIGNAL

C A P A C I T Y   A N A L Y S I S

APP	LN GR MVM	ADJ FLOW RATE	PMSV LT FLOW	ADJ SAT FLW RT	FLOW RATIO	CRIT ?	GREEN RATIO	LN GR CAPACITY	V/C RATIO
EB	L	751	0	3368	0.223	N	0.356	1198	0.627
	T	634	0	3402	0.186	N	0.356	1210	0.524
WB	R	436	0	1377	0.317	Y	0.356	490	0.890
NB	TR	1228	0	4751	0.258	Y	0.333	1584	0.775
SB									

CYCLE LENGTH : 90.0 SUM OF CRITICAL LANES' FLOW RATIOS : 0.575
LOSS TIME PER CYCLE : 6 INTERSECTION V/C : 0.616

L E V E L   O F   S E R V I C E

APP	LN GR MVM	V/C RATIO	GREEN RATIO	CYC LEN	1st DELAY	LN GR CAP	2nd DELAY	PF	LN GR DELAY	LN GR LOS	APP DELAY	APP LOS
EB	L	0.627	0.356	90	18.3	1198	0.8	1.00	19.1	C		
	T	0.524	0.356	90	17.5	1210	0.3	1.00	17.8	C	18.5	C
WB	R	0.890	0.356	90	20.8	490	12.7	1.00	33.5	D	33.3	D
NB	TR	0.775	0.333	90	20.5	1584	1.7	1.00	22.2	C	22.2	C
SB												

INTERSECTION DELAY : 22.1 secs/veh
LEVEL OF SERVICE : C

INTERSECTION :
BOYLSTON ST. @
BOYLSTON ST. @
SITE DRIVE
WEEKDAY PM 90 BUILD CBD?Y
UNSIGNALIZED
- MAJOR STREET RUNS EAST / WEST

U N S I G N A L I Z E D   C R I T I C A L   G A P S

APP	LEFT TURN	THROUGH	RIGHT TURN
	CRITICAL GAPS (SEC)		
EB	---	---	---
WB	5.50	---	---
NB	6.50	---	5.50

V O L U M E   A L L O C A T I O N   T O   L A N E S

APP	LANE 1 L	LANE 1 T	LANE 1 R	LANE 2 L	LANE 2 T	LANE 2 R	LANE 3 L	LANE 3 T	LANE 3 R
EB	0	367	0	0	362	5	0	0	0
WB	2	389	0	0	0	0	0	0	0
NB	3	0	5	0	0	0	0	0	0

U N S I G N A L I Z E D

APP		LANE 1	LANE 2	LANE 3
EB	RESERVE CAPACITY	---	---	---
	LEVEL OF SERVICE			
WB	RESERVE CAPACITY	462	---	---
	LEVEL OF SERVICE	A		
NB	RESERVE CAPACITY	337	---	---
	LEVEL OF SERVICE	B		

MAJOR STREET - EB/WB

APPENDIX B

WIND DEFINITION

Definition of the wind climate in Boston is complicated by the complex coastal geometry which can cause atmospheric stability effects to be significant for a wide range of wind speeds. Two types of stability can affect the winds: 1) stably stratified winds where the ground or water surface is cooler than the overlying air mass and 2) unstably stratified winds where the ground or water surface is warmer than the overlying air mass. Stability effects can effectively change the distribution of velocity with height above the surface. The coastal site can also influence wind climatology through temperature differences between land and water. These temperature differences can induce winds locally near the coast which are not closely associated with larger (synoptic or meso) scale atmospheric motions driving the general atmospheric circulations and weather patterns.

All of these thermally induced effects are most influential for the lower speed winds which are significant for pedestrian comfort applications. These effects become insignificant for the extreme wind events which the building frame and cladding are designed to resist. Turbulent mixing at high wind speeds destroys the thermal gradients within the atmospheric boundary layer.

Location of National Weather Service anemometers at Logan International Airport provides a good source of wind data which is in an open area away from significant influence of buildings but close enough to the City of Boston to have winds representative of the City. The airport has three basic sources of wind data: 1) hourly data from an anemometer at 22 feet above ground which provides representative data for pedestrian level winds, 2) fastest mile data from an anemometer which varied in elevation from 22 feet to 62 feet in elevation and which provides low probability event data not present in the hourly data at 22 feet, and 3) balloon wind profile data which provides information primarily on winds at the top of the atmospheric boundary layer.

An analysis of the surface winds was made to determine the consistency of the hourly and fastest mile wind data and to determine its applicability for use for pedestrian wind analysis. Figure B-1 shows the results of that analysis. The data points are the cumulative distribution of winds by direction (open circles) and individual fastest mile wind events (solid circles). The hourly data were translated to a gradient height of 900 feet with a 0.16 power law exponent. The fastest mile wind data was converted to an equivalent hourly wind using gust factors [B1] and translated to a gradient height of

900 feet with 0.16 power law. Thus, both sets of data were brought to a common time average and elevation. In actuality, the hourly data are not true hourly averages but are one-minute averages obtained once an hour, on the hour. The best estimate of the hourly mean from those samples is the sample value although some samples will obviously be too high or low.

The fastest mile events shown in Figure B-1 were established by obtaining the largest fastest mile wind magnitude for each of 8 wind directions for 42 years of Boston data. This information is maintained by the National Climatic Center in Asheville, North Carolina. The 336 resulting values corrected to hourly mean at gradient level, were ordered from highest to lowest and assigned probabilities of:

$$P_i = \frac{i}{N+1}$$

where i is the order number of the sample and N = 365,920, the total number of hours in the 42 year record. By using only the 95 largest values, the resulting velocity/probability combinations should reasonably represent the low probability events. The data plotted in Figure B-1 show that the fastest mile data form a continuous curve with the hourly data. Since fastest mile data was only available at 8 wind directions, the values at intermediate directions were interpolated.

The probabilistic model fit to the data shown in Figure 1 of the main text was, for each wind direction, a Weibull distribution:

$$P\,(>U) = A \exp\left[-\left(\frac{u}{c}\right)^k\right]$$

where A, c and k are constants. The value of A represents the fraction of time the wind blows from each of the 16 directions considered and was obtained from the published distribution of hourly data. The sum of A's from all wind directions was required to equal 1.0, a necessary condition for a consistent probability definition. The values of c and k were obtained by least squares fit.

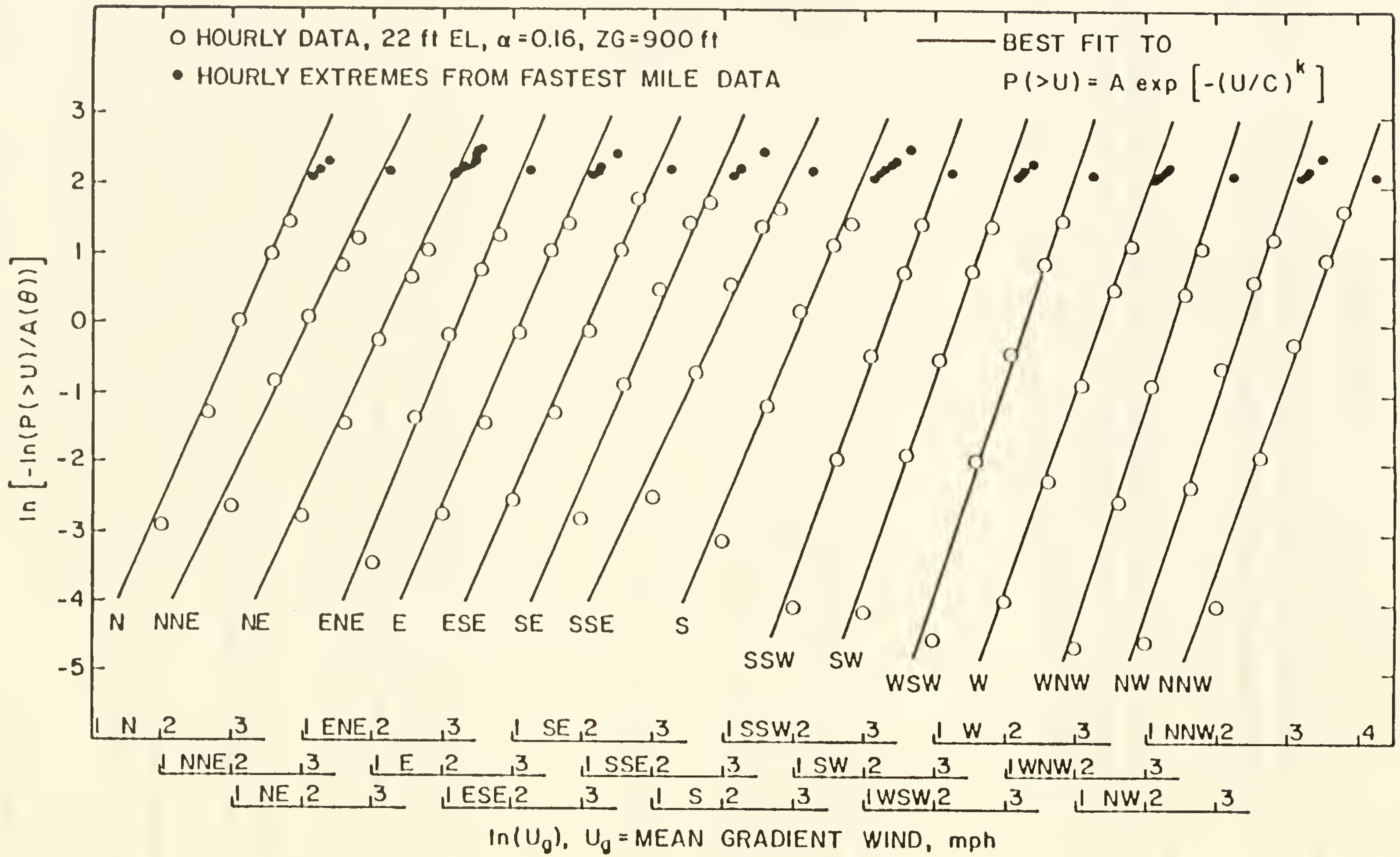
Examination of Figure B-1 shows that the data points do not follow precisely a straight line but have a definite curvature. This same curvature has been identified by Rijkoort [B2] to be due to atmospheric stability effects.

Because of the significant stability effects noted in the data, it is more accurate to use the surface wind data (22 feet) for pedestrian winds than to use gradient level winds. This data appears in Figure 1 of the main text.

REFERENCES

B1. Hollister, S. C., "The Engineering Interpretation of Weather Bureau Records for Wind Loading on Structures," Building Science Series 30-Wind Loads on Buildings and Structures, National bureau of Standards, 1970, pp. 151-164.

B2. Rijkoort, P.J., "A Compound Weibull Model for the Description of Surface Wind Velocity Distributions," Scientific Report W.R. 83-13, Koninklijk Nederlands Meteorlogisch Institute, 1983.



O HOURLY DATA, 22 ft EL, α=0.16, ZG=900 ft
• HOURLY EXTREMES FROM FASTEST MILE DATA
BEST FIT TO
P(>U) = A exp [-(U/C)^k]
ln [-ln(P(>U)/A(θ))]
3
2
1
0
-1
-2
-3
-4
-5
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW
ln(Ug), Ug = MEAN GRADIENT WIND, mph

FIGURE B–1

APPENDIX C

AIR QUALITY

C.1 Motor Vehicle Emissions

Motor vehicle emission rates used in this analysis were generated by the EPA MOBILE3 computer program*. Modeling runs were based on the MOBILE3 default national motor vehicle mix (see Table C.1), and an average December temperature of 30^{o}F. For the existing year, the 1985 Massachusetts registration distribution for light duty vehicles, light duty trucks, and heavy duty trucks (see Table C.2) was used, while MOBILE3 default values were used for the future year. The MOBILE3 default national cold/hot start mix (presented in Table C.3) was used for determining roadway emissions during the peak eight-hour period. A mix with a higher cold start percentage was used for the rush hour to represent the peak one-hour period (see Table C.4). Emission rates are based on peak one-hour and eight-hour travel speeds for vehicles approaching each intersection as estimated by Boston Traffic and Parking Department.** Table C.5 presents the composite free-flow emission rates for the peak one-hour and eight-hour periods. Idle mode emission rates for development of the linear queuing source strength were calculated based on a 5 mph vehicle speed and peak 1- and 8-hour vehicle operating conditions as described above. These are shown in Table C.6. The MOBILE3 idle mode emission rates were not considered as they reflect only hot stabilized conditions. The effect of the statewide inspection/maintenance (I/M) program was incorporated which includes a program implemented in 1983, a 13% stringency level, no mechanic training, an earliest model year of 15 years prior to the analysis year, vehicle type categories of LDGV, LDGT1 and LDGT2, and an idle test with cut points of 1.2% and 220 ppm for CO and HC, respectively. In addition, no alternative I/M credits or anti-tampering program was assumed. The complete MOBILE3 output is found following Table C.6.

C.2 CALINE3 Model

For each intersection studied the EPA Regions I and IV CALQ3*** computer program, was used to predict CO concentrations at sensitive receptor locations. The CALQ3 program utilizes the FHWA CALINE3* computer model combined with a queuing

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* EPA, User's Guide to MOBILE3: Mobile Source Emissions Model, EPA-460/3-84-002, Ann Arbor, MI, June, 1984.

** Personal Communication: Joe Beggan, Boston Traffic and Parking, July 18, 1988.

*** EPA Region I, "CALQ3 Modeling Procedures," January 3, 1986.

routine, based on the State of Connecticut's Queuing Model, to predict impacts from intersections. The CALQ3 intersection analysis involves superimposing motor vehicle idling emissions of queue links on free flow links. Traffic data used are discussed in the Transportation Component. These modeling runs were supplemented by a set of assumptions consistent with BRA and DEQE requirements which include an ambient air temperature of 30°F, and worst case meteorological conditions of Pasquill-Gifford Class D stability combined with a 1.0 m/s wind speed for peak one-hour and eight-hour periods. Also, a winter mixing height of 850 meters** was used. These meteorological data are appropriate for a December day during which peak CO concentrations are expected to occur. For each intersection, the full range of wind directions at 10 degree intervals was examined. In addition, a surface roughness (Z_o) of 321 cm (defined by CALINE3 for central business districts) and settling and deposition velocities of 0.0 cm/s were incorporated. CALQ3 model output is lengthy and will therefore be made available for review upon request.

C.3 Proposed Parking Garage Analysis

A separate analysis was performed to determine impacts of the project's proposed 70 space underground parking garage. The parking facility analysis predicted maximum 1-hour and 8-hour CO concentrations, for the 1990 build configuration, using the EPA MOBILE3 Computer Program, EPA Indirect Source Guidelines and Halitsky's gas diffusion equations. Concentrations were calculated at all receptor locations, in conjunction with a worst case wind speeds of 1 m/s.

Presently, design of the parking garage and its ventilation system have not been finalized, however, exhaust locations and typical ventilation system design specifications currently under consideration were modeled. Plans are that the proposed underground garage will be serviced by a forced air ventilation unit. Exhaust vents will be located 37 feet above ground level at the back of the project. The exhaust vents will have a total area of approximately 55 ft^2 with a flow rate totaling about 27,000 cfm.

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* FHWA, CALINE3 - A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets, FHWA/CA/TL-79/23, November, 1979.

** Holzworth, G.C., Mixing Heights, Wind Speeds, and Potential for Urban Air Quality Throughout the Contiguous United States, USEPA, AP-101, January, 1972.

Emissions were estimated using Worksheet 3 of the EPA Indirect Source Guidelines* These worksheets are included at the end of this appendix. The ventilation system will emit a total of .14 g/s of CO during the peak 1-hour period, and .06 g/s of CO during the 8-hour period.

The concentration of CO in the ventilation system exhaust was determined by the following formula:

$$X = 870\ (Q + (X_b)(F))/F$$

where: X = CO concentration in the ventilation exhaust (ppm)

Q = CO emission rate for the vent system (g/s)

X_b = Background concentration of CO in the makeup air assumed equal to the 1990 background concentrations used in this analysis (g/m^3)

F = Volumetric flow rate (m^3/s)

Background concentrations of 5.0 ppm and 3.0 ppm were used for the 1-hour and 8-hour periods. These levels are equivalent to 5.75 (10^{-3}) and 3.45 (10^{-3}) g/m^3, respectively. Concentrations of CO in each exhaust vent are predicted to be:

$$X = 14.56 \text{ ppm (1-Hour)}$$
$$= 7.10 \text{ ppm (8-Hour)}$$

For near-field receptors such as those being considered, ambient concentrations were scaled from the ventilation air concentrations using Halitsky's empirical model for gas diffusion near buildings. This model states that the ambient concentration X_a equals:

$$X_a = X/D$$

---

* EPA, Guidelines for Air Quality Maintenance Planning and Analysis Volume 9 (Revised): Evaluating Indirect Sources, Second Printing, EPA-450/4-78-001, Research Triangle Park, North Carolina, September 1978.

where D is a dilution factor defined as follows:

$$D = 2.22\, M \left[3.16 + \frac{0.1(S)}{(Ae)^{1/2}} \right]^2 \frac{V}{Ve}$$

The terms are defined as follows:

M = building configuration factor, equal to 4.0

S = shortest arc distance from source to receptor (m)

Ae = area of an exhaust opening, $5.11 m^2$

V = ambient wind velocity, 1.0 m/s

Ve = source exit velocity, 2.49 m/s

Table C.7 summarizes the model input parameters and results for each receptor examined for the one-hour and eight-hour periods. These input values represent actual physical characteristics of the ventilation system as presented above, source-receptor geometry, and worst case wind conditions.

TABLE C.1

NATIONWIDE AVERAGE

MOTOR VEHICLE MIX BY TYPE (VMT)*

Vehicle Type	Percentage of VMT 1988	1990
Light-Duty Gasoline Vehicles (LDGV)	65.0	63.5
Light-Duty Gasoline Trucks		
0-6000 lb GVW** (LDGT1)	12.5	11.5
Over 6000 lb GVW (LDGT2)	9.0	8.6
Heavy-Duty Gasoline Trucks (HDGV)	3.5	4.1
Light-Duty Diesel Vehicles (LDDV)	3.6	4.6
Light-Duty Diesel Trucks (LDDT)	1.5	2.1
Heavy-Duty Diesel Trucks (HDDT)	4.2	4.9
Motorcycles (MC)	0.7	0.7

* EPA, User's Guide to MOBILE3: Mobile Source Emissions Model, EPA-460/3-84-002, Ann Arbor, MI, June, 1984.

** Gross vehicle weight.

TABLE C.2

1985 MASSACHUSETTS VEHICLE REGISTRIBUTION DISTRIBUTION

Vehicle Age In Years	Percent of Total Vehicles LDGV, LDDV	LDGT, LDDT	HDT (Gas & Diesel)
1	7.07	6.3	4.2
2	10.13	6.9	7.2
3	8.51	5.8	5.4
4	7.74	5.9	5.3
5	7.96	12.6	8.4
6	8.36	9.8	10.0
7	8.40	8.8	8.2
8	7.88	6.5	6.2
9	6.65	4.6	4.8
10	6.00	6.6	6.4
11	6.00	5.7	6.4
12	5.00	4.6	7.8
13	3.00	3.4	3.8
14	2.00	2.7	3.2
15	1.50	2.2	3.0
16	1.10	1.8	2.4
17	0.90	1.7	2.1
18	0.70	1.6	1.9
19	0.60	1.4	1.8
20 +	0.50	1.1	1.5
TOTAL	100.0	100.0	100.0

Source: Massachusetts Department of Environmental Quality Engineering

TABLE C.3

NATIONWIDE AVERAGE

COLD/HOT START MIX FOR MOTOR VEHICLES

Vehicles Cold Start Mode	20.6%
Vehicles Hot Start Mode	27.3%
Vehicles Hot Stabilized Mode	52.1%
Total	100.0%

TABLE C.4

RUSH HOUR COLD/HOT

START MIX FOR MOTOR VEHICLES

Vehicles Cold Start Mode	50.0%
Vehicles Hot Start Mode	10.0%
Vehicles Hot Stabilized Mode	40.0%
Total	100.0%

TABLE C.5

COMPOSITE CO EMISSION RATES

Averaging Period	Roadway	Speed (mph)	CO Emissions Rate (grams/mile) 1988	1990
1-Hour	Boylston Street	12	93.12	77.66
	Tremont Street	15	78.84	66.17
	Charles Approaching Boylston	12	93.12	77.66
	Charles After Boylston	15	78.84	66.17
	Parking Garage	15	—	66.17
8-Hour	Boylston Street	20	38.88	32.55
	Tremont Street	25	30.71	25.82
	Charles Approaching Boylston	20	38.88	32.55
	Charles After Boylston	25	30.71	25.86
	Parking Garage	15	—	41.61

TABLE C.6

IDLE MODE EMISSION RATES

Averaging Period	CO Emission Rate (grams/minute 1988	1990
1-Hour	13.28	10.73
8-Hour	8.52	6.83

TABLE C.7

PROPOSED PARKING GARAGE ANALYSIS

INPUTS AND MAXIMUM 1-HOUR AND * HOUR IMPACTS*

Intersection	Receptor Number	Receptor Description	S(m)	D	Xa (ppm) 1-Hour	Xa (ppm) 8-Hour
Boylston/Tremont	1	Brighams	146	330	0.044	0.022
	2	Telephones	160	374	0.039	0.019
	3	Pharmacy	162	380	0.038	0.019
	4	Welfare Department	186	463	0.031	0.015
	5	Masonic Temple	177	431	0.034	0.016
Boylston/Charles	1	Commons Entrance 1	79	158	0.092	0.045
	2	Commons Entrance 2	122	261	0.056	0.027
	3	Gardens Entrance	139	309	0.047	0.023
	4	Statue	169	403	0.036	0.018
	5	Furniture Store	123	264	0.055	0.027
	6	Bus Stop	77	154	0.095	0.046
Additional Receptors		Cafe	30	72	0.202	0.099
		Front Door	59	119	0.122	0.060

* X = 14.56 ppm (1-Hour), 7.10 ppm (8-Hour)

V = 1.0 m/s

Ve = 2.49 m/s

Ae = 5.11 m^2

M = 4.0

```
MOBILE3 EXISTING - INTERSECTION ANALYSIS

I/M PROGRAM SELECTED:

    START YEAR (JANUARY 1):            1983
    PRE-1981 MYR STRINGENCY RATE:      13%
    MECHANIC TRAINING PROGRAM?:        NO
    FIRST MODEL YEAR COVERED:          1973
    LAST MODEL YEAR COVERED:           1988
    VEHICLE TYPES COVERED:             LDGV, LDGT1, LDGT2
    1981 & LATER MYR TEST TYPE:        IDLE
    1981 & LATER MYR TEST CUTPOINTS:   1.2% ICO / 220 PPM IHC

TOTAL HC EMISSION FACTORS INCLUDE EVAPORATIVE HC EMISSION FACTORS

--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS

CAL. YEAR: 1988            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES           AMBIENT TEMP:  30.0 (F)
                 ANTI-TAM. PROGRAM: NO          OPERATING MODE:  50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.:  5.0    5.0    5.0           5.0    5.0    5.0    5.0    5.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO:137.29 234.33 255.71 243.26 412.64   4.00   4.63  35.05 222.74 159.31
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES           AMBIENT TEMP:  30.0 (F)
                 ANTI-TAM. PROGRAM: NO          OPERATING MODE:  50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LOGT1  LDGT2   LOGT   HDGV   LODV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 10.0   10.0   10.0          10.0   10.0   10.0   10.0   10.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 93.69 150.57 157.67 153.54 274.54   2.76   3.19  24.17 106.95 105.48
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES           AMBIENT TEMP:  30.0 (F)
                 ANTI-TAM. PROGRAM: NO          OPERATING MODE:  50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LOOT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 12.0   12.0   12.0          12.0   12.0   12.0   12.0   12.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 83.54 132.46 136.70 134.23 236.86   2.41   2.79  21.10  87.69  93.12
--------------------------------------------------------------------------------
```

```
USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS

CAL. YEAR: 1988            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES           AMBIENT TEMP:  30.0 (F)
                 ANTI-TAM. PROGRAM: NO          OPERATING MODE:  50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LODV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 14.0   14.0   14.0          14.0   14.0   14.0   14.0   14.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 75.24 118.14 120.30 119.04 206.17   2.12   2.45  18.55  74.53  83.16
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES           AMBIENT TEMP:  30.0 (F)
                 ANTI-TAM. PROGRAM: NO          OPERATING MODE:  50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LODV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 71.60 111.96 113.30 112.52 192.98   1.99   2.30  17.44  69.43  78.84
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES           AMBIENT TEMP:  30.0 (F)
                 ANTI-TAM. PROGRAM: NO          OPERATING MODE:  50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 17.0   17.0   17.0          17.0   17.0   17.0   17.0   17.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 65.04 101.02 101.09 101.05 170.20   1.77   2.05  15.50  61.23  71.16
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES           AMBIENT TEMP:  30.0 (F)
                 ANTI-TAM. PROGRAM: NO          OPERATING MODE:  50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 18.0   18.0   18.0          18.0   18.0   18.0   18.0   18.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 62.06  96.11  95.70  95.94 160.37   1.67   1.93  14.66  57.86  67.72
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS
```

```
CAL  YEAR: 1988              REGION: LOW              ALTITUDE:   500  FT
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
                  ANTI-TAM  PROGRAM: NO         OPERATING MODE:    50.0 / 10.0 / 50.0

VEH  TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD :  20.0   20.0   20.0          20.0   20.0   20.0   20.0   20.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EX     CO: 56.59  87.16  86.04  86.70 143.32   1.50   1.74  13.17  52.16  61.46
-    ---------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988              REGION: LOW              ALTITUDE:   500  FT
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
                  ANTI-TAM. PROGRAM: NO         OPERATING MODE:    50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  21.0   21.0   21.0          21.0   21.0   21.0   21.0   21.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 54.05  83.05  81.68  82.48 135.94   1.43   1.65  12.52  49.71  58.60
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL  YEAR: 1988              REGION: LOW              ALTITUDE:   500  FT
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
                  ANTI-TAM. PROGRAM: NO         OPERATING MODE:    50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  22.0   22.0   22.0          22.0   22.0   22.0   22.0   22.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 51.64  79.13  77.60  78.49 129.22   1.36   1.57  11.92  47.45  55.89
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL  YEAR: 1988              REGION: LOW              ALTITUDE:   500  FT
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
                  ANTI-TAM  PROGRAM: NO         OPERATING MODE:    50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD :  25.0   25.0   25.0          25.0   25.0   25.0   25.0   25.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 45.02  68.46  66.70  67.72 112.46   1.19   1.37  10.41  41.59  48.57
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988              REGION: LOW              ALTITUDE:   500. FT.
```

```
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
                  ANTI-TAM. PROGRAM: NO         OPERATING MODE:    20.6 / 27.3 / 20.6

VEH  TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD :   5.0    5.0    5.0           5.0    5.0    5.0    5.0    5.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 81.95 141.43 157.00 147.93 412.64   3.48   4.06  35.05 135.20 102.21
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988              REGION: LOW              ALTITUDE:   500. FT.
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
                  ANTI-TAM. PROGRAM: NO         OPERATING MODE:    20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  10.0   10.0   10.0          10.0   10.0   10.0   10.0   10.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 55.55  90.37  95.81  92.64 274.54   2.40   2.80  24.17  64.92  67.20
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988              REGION: LOW              ALTITUDE:   500. FT.
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
                  ANTI-TAM. PROGRAM: NO         OPERATING MODE:    20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  12.0   12.0   12.0          12.0   12.0   12.0   12.0   12.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 49.48  78.44  82.92  80.89 236.86   2.09   2.44  21.10  53.23  59.26
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988              REGION: LOW              ALTITUDE:   500. FT.
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
                  ANTI-TAM. PROGRAM: NO         OPERATING MODE:    20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  14.0   14.0   14.0          14.0   14.0   14.0   14.0   14.0
  VMT MIX:  0.650  0.125  0.090         0.035  0.036  0.015  0.042  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 44.54  70.83  72.89  71.69 206.17   1.84   2.15  18.55  45.24  52.81
--------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988              REGION: LOW              ALTITUDE:   500. FT.
                        I/M PROGRAM: YES          AMBIENT TEMP:    30.0 (F)
```

ANTI-TAM PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	15.0	15.0	15.0		15.0	15.0	15.0	15.0	15.0	
VMT MIX:	0.650	0.125	0.090		0.035	0.036	0.015	0.042	0.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
EXHST CO:	42.37	67.12	68.63	67.75	192.98	1.73	2.02	17.44	42.14	50.02

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS

CAL. YEAR: 1988 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 30.0 (F)
ANTI-TAM PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	17.0	17.0	17.0		17.0	17.0	17.0	17.0	17.0	
VMT MIX:	0.650	0.125	0.090		0.035	0.036	0.015	0.042	0.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
EXHST CO:	38.49	60.57	61.22	60.84	170.20	1.54	1.79	15.50	37.17	45.08

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 30.0 (F)
ANTI-TAM PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	18.0	18.0	18.0		18.0	18.0	18.0	18.0	18.0	
VMT MIX:	0.650	0.125	0.090		0.035	0.036	0.015	0.042	0.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
EXHST CO:	36.72	57.64	57.95	57.77	160.37	1.45	1.70	14.66	35.12	42.87

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 30.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	20.0	20.0	20.0		20.0	20.0	20.0	20.0	20.0	
VMT MIX:	0.650	0.125	0.090		0.035	0.036	0.015	0.042	0.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
EXHST CO:	33.48	52.28	52.11	52.21	143.32	1.31	1.52	13.17	31.66	38.88

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS

CAL. YEAR: 1988 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 30.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	21.0	21.0	21.0		21.0	21.0	21.0	21.0	21.0	
VMT MIX:	0.650	0.125	0.090		0.035	0.036	0.015	0.042	0.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
EXHST CO:	31.98	49.82	49.48	49.68	135.94	1.24	1.45	12.52	30.17	37.06

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1988 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 30.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	22.0	22.0	22.0		22.0	22.0	22.0	22.0	22.0	
VMT MIX:	0.650	0.125	0.090		0.035	0.036	0.015	0.042	0.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
EXHST CO:	30.55	47.48	47.01	47.28	129.22	1.18	1.38	11.92	28.80	35.34

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS

CAL. YEAR: 1988 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 30.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	25.0	25.0	25.0		25.0	25.0	25.0	25.0	25.0	
VMT MIX:	0.650	0.125	0.090		0.035	0.036	0.015	0.042	0.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
EXHST CO:	26.64	41.09	40.43	40.81	112.46	1.03	1.21	10.41	25.25	30.71

```
MOBILE3 1990 - INTERSECTION ANALYSIS

I/M PROGRAM SELECTED:

    START YEAR (JANUARY 1):            1983
    PRE-1981 MYR STRINGENCY RATE:      13%
    MECHANIC TRAINING PROGRAM?         NO
    FIRST MODEL YEAR COVERED:          1975
    LAST MODEL YEAR COVERED:           1990
    VEHICLE TYPES COVERED:             LDGV, LDGT1, LDGT2
    1981 & LATER MYR TEST TYPE         IDLE
    1981 & LATER MYR TEST CUTPOINTS:   1.2% ICO / 220 PPM IHC

TOTAL HC EMISSION FACTORS INCLUDE EVAPORATIVE HC EMISSION FACTORS

-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES          AMBIENT TEMP:   30.0 (F)
                 ANTI-TAM PROGRAM: NO         OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.:  5.0    5.0    5.0           5.0    5.0    5.0    5.0    5.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO:115.41 204.23 223.93 212.64 227.33   3.98   4.55  28.96 221.75 128.70
-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES          AMBIENT TEMP:   30.0 (F)
                 ANTI-TAM PROGRAM: NO         OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 10.0   10.0   10.0          10.0   10.0   10.0   10.0   10.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 81.81 133.10 139.72 135.93 151.24   2.74   3.14  19.97 106.53  87.44
-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES          AMBIENT TEMP:   30.0 (F)
                 ANTI-TAM. PROGRAM: NO        OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 12.0   12.0   12.0          12.0   12.0   12.0   12.0   12.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 73.47 117.56 121.61 119.29 130.49   2.39   2.74  17.43  87.37  77.66
-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES          AMBIENT TEMP:   30.0 (F)
                 ANTI-TAM. PROGRAM: NO        OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 14.0   14.0   14.0          14.0   14.0   14.0   14.0   14.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 66.50 105.18 107.39 106.12 113.58   2.11   2.41  15.33  74.27  69.68
-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES          AMBIENT TEMP:   30.0 (F)
                 ANTI-TAM PROGRAM: NO         OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 63.38  99.82 101.31 100.46 106.31   1.98   2.26  14.41  69.19  66.17
-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES          AMBIENT TEMP:   30.0 (F)
                 ANTI-TAM. PROGRAM: NO        OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 17.0   17.0   17.0          17.0   17.0   17.0   17.0   17.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 57.73  90.29  90.67  90.46  93.77   1.76   2.01  12.81  61.03  59.90
-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES          AMBIENT TEMP:   30.0 (F)
                 ANTI-TAM. PROGRAM: NO        OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 18.0   18.0   18.0          18.0   18.0   18.0   18.0   18.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 55.15  86.01  85.97  85.99  88.35   1.66   1.90  12.11  57.68  57.08
-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT.
                      I/M PROGRAM: YES          AMBIENT TEMP:   30.0 (F)
                 ANTI-TAM. PROGRAM: NO        OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 20.0   20.0   20.0          20.0   20.0   20.0   20.0   20.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 50.37  78.16  77.51  77.88  78.96   1.49   1.71  10.88  52.00  51.91
-------------------------------------------------------------------------------

CAL. YEAR: 1990            REGION: LOW              ALTITUDE:  500  FT
```

```
                 I/M PROGRAM  YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM  PROGRAM  NO       OPERATING MODE:   50.0 / 10.0 / 50.0

VEH  TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD :  21.0   21.0   21.0          21.0   21.0   21.0   21.0   21.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 48.15  74.55  73.68  74.18  74.89   1.42   1.63  10.35  49.56  49.54
--------------------------------------------------------------------------------

CAL  YEAR: 1990             REGION: LOW               ALTITUDE:  500  FT
                 I/M PROGRAM  YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM  PROGRAM  NO       OPERATING MODE:   50.0 / 10.0 / 50.0

VEH  TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD :  22.0   22.0   22.0          22.0   22.0   22.0   22.0   22.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 46.03  71.11  70.09  70.67  71.19   1.35   1.55   9.85  47.31  47.29
--------------------------------------------------------------------------------

CAL  YEAR: 1990             REGION: LOW               ALTITUDE:  500  FT
                 I/M PROGRAM  YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM  PROGRAM: NO       OPERATING MODE:   50.0 / 10.0 / 50.0

VEH  TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD :  25.0   25.0   25.0          25.0   25.0   25.0   25.0   25.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 40.21  61.71  60.48  61.18  61.95   1.18   1.35   8.60  41.47  41.19
--------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW               ALTITUDE:  500  FT
                 I/M PROGRAM: YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM  PROGRAM: NO       OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD :   5.0    5.0    5.0           5.0    5.0    5.0    5.0    5.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 68.99 124.35 137.85 130.12 227.33   3.45   3.99  28.96 134.64  81.91
--------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW               ALTITUDE:  500  FT
                 I/M PROGRAM: YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM  PROGRAM: NO       OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  10.0   10.0   10.0          10.0   10.0   10.0   10.0   10.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)

EXHST  CO: 48.61  80.60  85.26  82.59 151.24   2.38   2.75  19.97  64.68  55.28
--------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW               ALTITUDE:  500  FT
                 I/M PROGRAM: YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM. PROGRAM: NO       OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  12.0   12.0   12.0          12.0   12.0   12.0   12.0   12.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 43.61  71.13  74.10  72.40 130.49   2.08   2.40  17.43  53.05  48.98
--------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW               ALTITUDE:  500. FT
                 I/M PROGRAM: YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM  PROGRAM: NO       OPERATING MODE:   20.6 / 27.3 / 20.6

VEH  TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  14.0   14.0   14.0          14.0   14.0   14.0   14.0   14.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 39.45  63.62  65.38  64.37 113.58   1.83   2.11  15.33  45.09  43.85
--------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW               ALTITUDE:  500  FT
                 I/M PROGRAM: YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM. PROGRAM: NO       OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD.:  15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 37.60  60.37  61.66  60.92 106.31   1.72   1.99  14.41  42.01  41.61
--------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW               ALTITUDE:  500  FT
                 I/M PROGRAM  YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM  PROGRAM: NO       OPERATING MODE:   20.6 / 27.3 / 20.6

VEH  TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD :  17.0   17.0   17.0          17.0   17.0   17.0   17.0   17.0
  VMT MIX:  0.635  0.115  0.086         0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 34.25  54.61  55.17  54.85  93.77   1.53   1.76  12.81  37.06  37.62
--------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW               ALTITUDE:  500  FT
                 I/M PROGRAM: YES         AMBIENT TEMP:   30.0 (F)
            ANTI-TAM  PROGRAM: NO       OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
```

```
VEH  SPD : 18 0   18 0   18 0            18 0   18 0   18 0   18 0   18 0
  VMT MIX:  0 635  0 115  0.086           0.041  0.046  0.021  0 049  0 007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 32.71  52.02  52.30  52 14  88.35   1.44   1.67  12 11  35.02  35 82
-------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW            ALTITUDE:  500  FT
                      I/M PROGRAM: YES        AMBIENT TEMP:   30 0 (F)
                ANTI-TAM  PROGRAM: NO      OPERATING MODE:   20.6 / 27 3 / 20 6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD : 20 0   20.0   20 0            20 0 • 20.0   20 0   20 0   20 0
  VMT MIX:  0 635  0 115  0 086           0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 29.87  47.29  47 16  47 23  78 96   1.30   1.50  10 88  31 58  32 55
-------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW            ALTITUDE:  500  FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   30 0 (F)
                ANTI-TAM  PROGRAM: NO      OPERATING MODE:   20 6 / 27.3 / 20 6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD : 21 0   21.0   21 0            21 0   21 0   21 0   21.0   21 0
  VMT MIX:  0.635  0.115  0.086           0.041  0.046  0.021  0.049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 28.56  45.11  44 83  44.99  74.89   1.23   1 43  10.35  30.09  31 06
-------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW            ALTITUDE:  500  FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   30.0 (F)
                ANTI-TAM. PROGRAM: NO      OPERATING MODE:   20.6 / 27.3 / 20 6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD : 22 0   22 0   22.0            22 0   22.0   22 0   22 0   22.0
  VMT MIX:  0.635  0.115  0.086           0.041  0 046  0.021  0 049  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 27.30  43.03  42.65  42.87  71.19   1.17   1.36   9.85  28.72  29.64
-------------------------------------------------------------------------------

CAL. YEAR: 1990             REGION: LOW            ALTITUDE:  500  FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   36 0 (F)
                ANTI-TAM. PROGRAM: NO      OPERATING MODE:   20 6 / 27.3 / 20 6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
            ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH  SPD : 25 0   25.0   25 0            25 0   25 0   25 0   25 0   25 0
  VMT MIX:  0.635  0.115  0.086           0.041  0.046  0.021  0.049  0 007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 23.86  37.35  36.82  37 12  61.95   1.03   1.19   8 60  25.18  25 82
-------------------------------------------------------------------------------
```

WORKSHEET 3 - AREA SOURCE EMISSIONS COMPUTATION

Area Source 144 Boylston Garage
Case # Build Year 1990 Averaging Time 1/ Hour

Step	Symbol	Input/Units	Traffic Stream			
1	Brt	Base running time				
1.1		Base approach time(s)	15			
1.2		Base entrance time(s)	10			
1.3		Base movement-in time(s)	90			
1.4		Base stop, base start time(s)	10			
1.5		Base movement-out time(s)	90			
1.6		Base exit time(s)	10			
1.7		Base departure time(s)	15			
1.8		Total base running time(s)	240 s			
2	A	Area of parking lot (m^2)	2487 m^2			
3	i	Entrance approach identification				
4	Ve_i	Entrance demand volume (vph)	7			
5	Ce_i	Entrance approach capacities (vph)	490			
6	i	Exit approach identification				
7	Vx_i	Exit demand volume (vph)	8			
8	Cx_i	Exit approach capacities (vph)	367			
9		Number of parking spaces occupied				
10	F	Emissions	66.2 gm/mi			
11	Pc	Capacity of parking lot (veh)	70			
12	Rmi	Excess movement-in time(s)				
13	Fet	Facility emptying time(s)				
14		Excess running time				
14.1	Ve_i/Ce_i	Entering volume-to-capacity ratio	.01			
14.2	Vx_i/Cx_i	Exiting volume-to-capacity ratio	.02			
14.3	Re_i	Excess running time entering parking lot	.01			
14.4	Rx_i	Excess running time exiting parking lot	.02			
15	Te_i	Total entering running time (s/veh)	120			
16	Rmo	Excess running time moving out of parking stalls (s/veh)				
17	Tx_i	Total exiting running time (s/veh)	120			
18	Qa	Total emission rate from a parking lot (g/m^2 - s)	.14 g/s			
19	Qa'	Area source emission rate without the emissions from internal road segment. i				

$$\left\{\left[Te_i\,(s/veh) \times Ve_i\,(veh) \times F\,(g/mi)\right] + \left[Tx_i\,(s/veh) \times Vx_i\,(veh) \times F\,(g/mi)\right]\right\}$$

$$\times \frac{15\ mi}{hr} \times \frac{hr}{3600\ s} \times \frac{1}{3600\ s} : \frac{gm}{sec}$$

Capacities:

$$C_1 = \frac{V_0 e^{-a}}{1-e^{a}}\ ;\quad a = V_0 t/3600$$

V_0 = volume of main road
t = critical gap, 4.5 sec

WORKSHEET 3 - AREA SOURCE EMISSIONS COMPUTATION

Area Source 144 Boylston Garage

Case # Build Year 1990 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	Brt	Base running time				
1.1		Base approach time(s)				
1.2		Base entrance time(s)				
1.3		Base movement-in time(s)				
1.4		Base stop, base start time(s)				
1.5		Base movement-out time(s)				
1.6		Base exit time(s)				
1.7		Base departure time(s)				
1.8		Total base running time(s)	240			
2	A	Area of parking lot (m^2)	2487			
3	i	Entrance approach identification				
4	Ve_i	Entrance demand volume. (vph)	5			
5	Ce_i	Entrance approach capacities (vph)				
6	i	Exit approach identification				
7	Vx_i	Exit demand volume (vph)	6			
8	Cx_i	Exit approach capacities (vph)				
9		Number of parking spaces occupied				
10	F	Emissions	41.61 gm/mi			
11	Pc	Capacity of parking lot (veh)				
12	Rmi	Excess movement-in time(s)				
13	Fet	Facility emptying time(s)				
14		Excess running time				
14.1	Ve_i/Ce_i	Entering volume-to-capacity ratio				
14.2	Vx_i/Cx_i	Exiting volume-to-capacity ratio				
14.3	Re_i	Excess running time entering parking lot				
14.4	Rx_i	Excess running time exiting parking lot				
15	Te_i	Total entering running time (s/veh)	120			
16	Rmo	Excess running time moving out of parking stalls (s/veh)				
17	Tx_i	Total exiting running time (s/veh)	120			
18	Qa	Total emission rate from a parking lot (g/m^2 - s) *	.06 g/s			
19	Qa'	Area source emission rate without the emissions from internal road segment. i				

$$* \left\{ \left[Te_i\,(s/veh) \times Ve_i\,(veh) \right] + \left[Tx_i\,(s/veh) \times Vx_i\,(veh) \right] \times F\,(g/mi) \times \frac{15\,mi}{hr} \times \frac{hr}{3600\,s} \times \frac{1}{3600\,s} = \frac{gm}{sec} \right.$$